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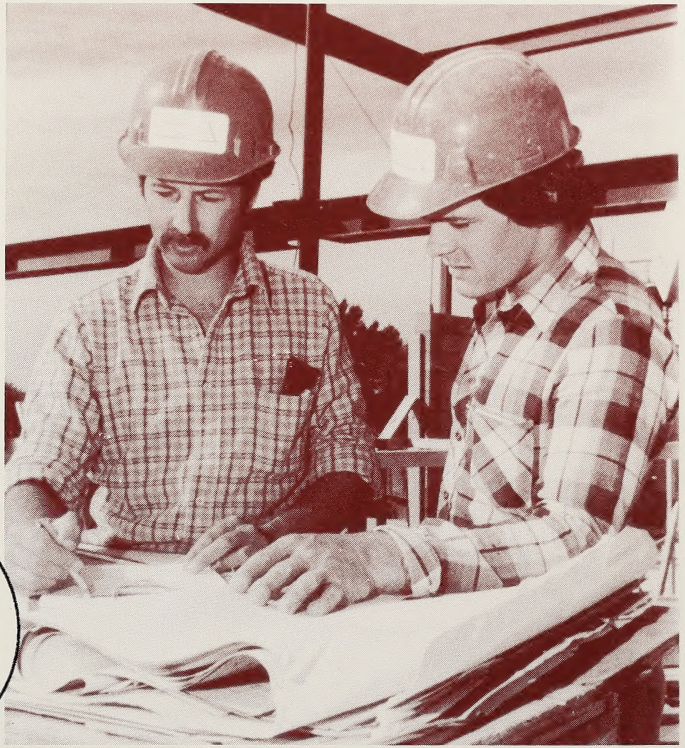
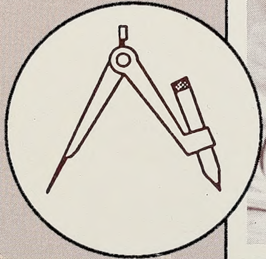
MEASUREMENT and GEOMETRY

MODULE 6





MATHEMATICS 7

Distance Learning

Alberta EDUCATION

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Mathematics 7

Module 6: Measurement and Geometry

MODULE BOOKLET

Mathematics 7
Student Module
Module 6
Measurement and Geometry
Alberta Distance Learning Centre
ISBN No. 0-7741-0206-3

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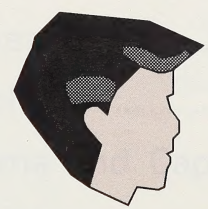

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CONTENTS AT A GLANCE

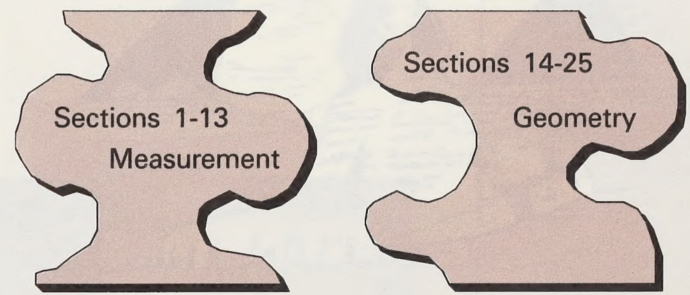
What Lies Ahead

In this Module Introduction you will preview the module components and you will discover how the module will be evaluated.

Working Together

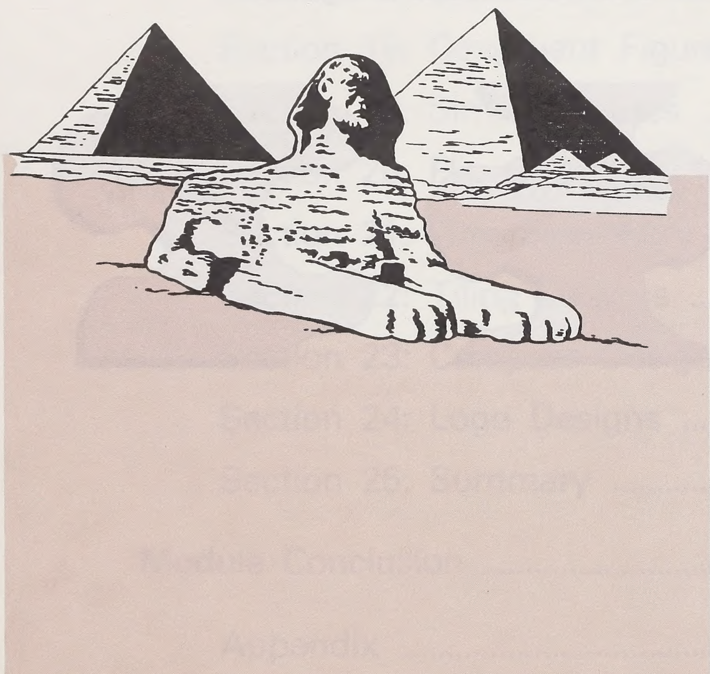
In this module you will be learning about measurement and geometry.

This is how the module is organized.



Geometry is one of the oldest branches of mathematics. The word geometry comes from the Greek "geo" meaning earth and "metros" meaning to measure.

Early Egyptian architects used measurement and geometry to design the pyramids.



Architects today use measurement and geometry to design modern-day buildings.

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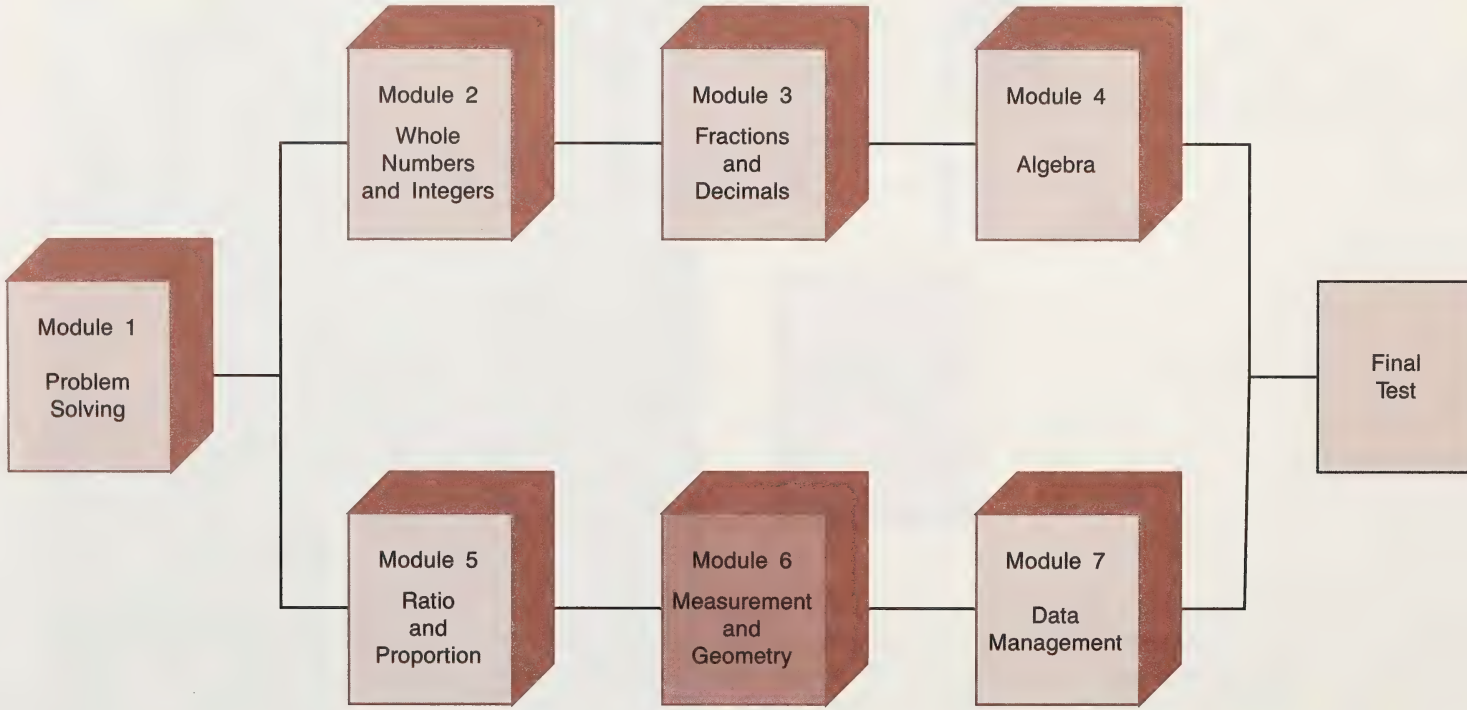
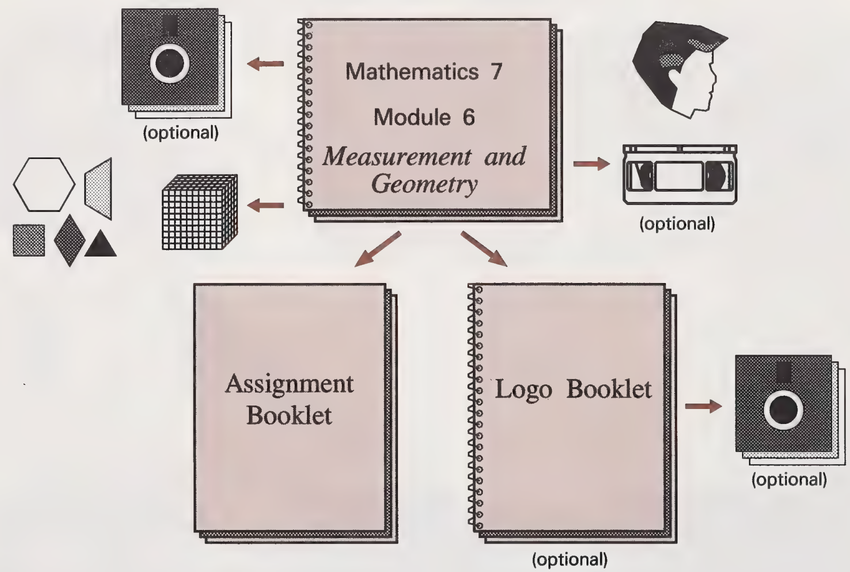
Course Overview



Mathematics 7 has seven modules and a final supervised test. This booklet is part of Module 6.

Module 6 Components



This booklet contains most of the instructional content. It is also designed to guide your learning and direct you to other components of the module. The video and computer activities in this booklet are optional. There are print alternatives. Your learning facilitator will help you check your answers to the activities in this booklet.

Your mark on this module will be determined by your work in the Assignment Booklet.

Take time to preview this booklet before you begin Section 1.

PART ONE

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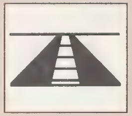
Part One deals with measurement. You probably use measurement frequently in your everyday life. For example, you measure when you cook. Flour is measured in millilitres, meat is measured in kilograms, and the dimensions of a pan are given in centimetres. You could even discuss the angle at which carrots are chopped.

GETTING SET



What Lies Ahead

In this section you will review these skills.

- estimating and measuring the length, mass, capacity, perimeter, volume, and area of an object
- comparing the areas of objects with the same perimeter
- comparing the perimeters of objects with the same area
- relating volume and capacity in the metric system
- estimating and measuring angles
- changing from one unit to another

Working Together

To begin this module you will examine skills with measurement developed in previous schooling.

It is important that you maintain these skills with measurement.

The following Pretest will help you and your learning facilitator discover your strengths and weaknesses.

Pretest

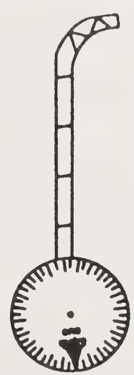
Space for Your Work

1. Define measurement.

2. Why do you think the metric system is used by most countries in the world today?

3. Can you ever measure absolutely accurately? Why or why not?

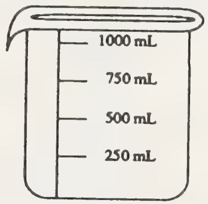
4. What do the following instruments measure?

   a. 

   b. 

Space for Your Work

c.



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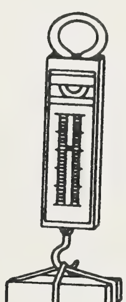

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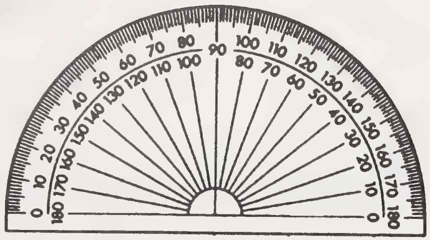

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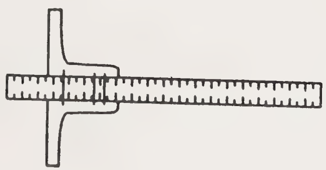

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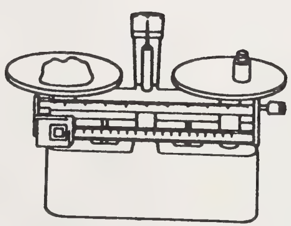


i.

Space for Your Work

Space for Your Work

j.

k.

Space for Your Work

5. What unit would be appropriate to measure each of these?

   a. the distance from Calgary to Banff

   b. the depth of the sea

   c. the length of a fire hose

   d. the width of a book

   e. the thickness of a sheet of paper

   f. your height

6. Is each statement reasonable? Answer yes or no.

   a. The pencil is 7 cm long.

   b. The mosquito is 7 m long.

   c. The flagpole is 7 mm long.

   d. The bike trail is 7 km long.

Space for Your Work

7. Measure the following line segments.

   a. ________

   b. ____________________

   c. ____

8. What unit would you use to measure each of these masses?

   a. a stove

   b. a toaster

   c. a box of paper clips

   d. yourself

   e. a hair

Space for Your Work

9. Is each statement reasonable?

   a. A motorcycle has a mass of 0.3 t.

   b. A tennis ball has a mass of 3 kg.

   c. A concrete block has a mass of 11 kg.

   d. A bicycle has a mass of 11 g.

   e. A basketball has a mass of 566 g.

   f. A bag of potato chips has a mass of 450 g.

10. What unit would you use to measure the capacity of each of these?

    a. a tube of toothpaste

    b. a carton of milk

    c. a tanker truck

    d. a thermos

    e. a honey jar

    f. an eye dropper

Space for Your Work

11. Is each statement reasonable?

    a. A hot water tank has a capacity of 180 mL.

    b. A cereal bowl has a capacity of 225 mL.

    c. A drinking straw has a capacity of 5 mL.

    d. A water balloon has a capacity of 250 mL.

    e. A garbage can has a capacity of 15 L.

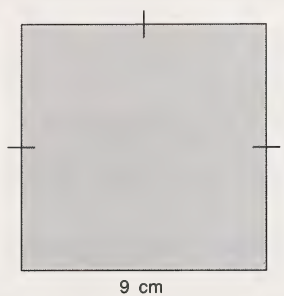
    f. A bottle cap has a capacity of 1 L.

12. Give the perimeter of the figures labelled "Section 1 Figures" in the appendix of this booklet. (You may cut out the figures if you wish.)

Space for Your Work

13. Find the perimeter of each sketch.

a.



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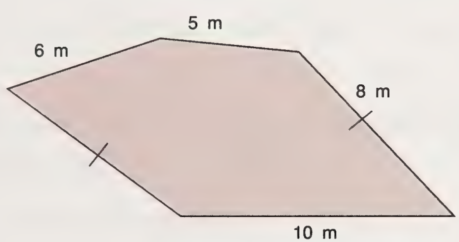

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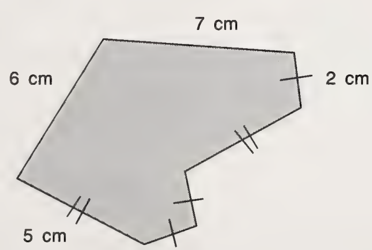
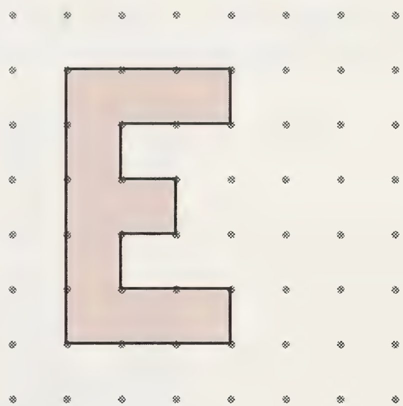


Space for Your Work

14. Give the area of each figure.

a.



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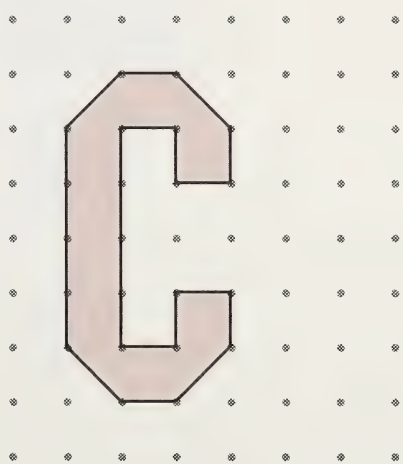


Space for Your Work

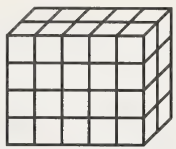
15. Which unit would you use to measure the area of each of the following?
    a. a garden
    b. a place mat
    c. a farm
    d. a province
    e. a stamp

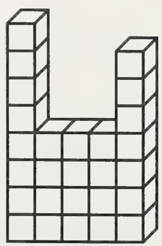
16. Is each statement reasonable?
    a. The area of a hockey rink is 1586 km^2.
    b. The area of a credit card is 46.75 cm^2.
    c. The area of a felt pennant is 0.3 m^2.
    d. The area of a stop sign is 4320 cm^2.
    e. The area of a ball park is 5.1 ha.

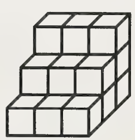
17. Are you concerned with perimeter or area when you do the following?
    a. paint the walls of your livingroom
    b. fertilize your lawn
    c. fence your yard
    d. frame a picture

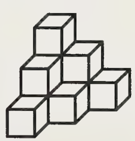
Space for Your Work

18. Find the volume of the following. (You may use base 10 blocks to construct the figure first.)

a. 

b. 

c. 

d. 

Space for Your Work

19. What unit would you use to measure the volume of each of these?

    a. a hamster cage

    b. a moving truck

    c. a box of cereal

    d. a swimming pool

20. Is each statement reasonable?

    a. The volume of a walnut is 12 m^3.

    b. The volume of a washroom is 0.1 m^3.

    c. The volume of a softball is 480 cm^3.

    d. The volume of a loaf of bread is 3500 m^3.

Space for Your Work

21. Complete the following.

   a. 30 cm = $\boxed{}$ mm

   b. 152 mm = $\boxed{}$ m

   c. 3 L = $\boxed{}$ mL

   d. 518 g = $\boxed{}$ kg

22. Complete the following.

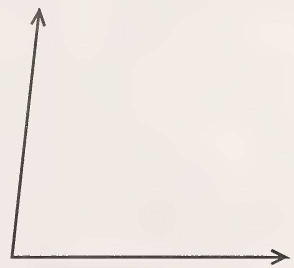
   a. 13 mL = $\boxed{}$ cm^3

   b. 2 L = $\boxed{}$ cm^3

Space for Your Work

23. Measure the following angles.

a.



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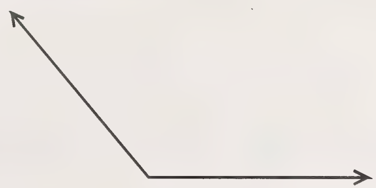

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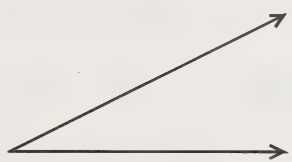

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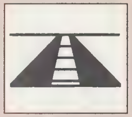
See your learning facilitator to check your answers and to receive further instructions.

THE DEVELOPMENT OF MEASUREMENT



What Lies Ahead

In this section you will learn about the measurement process and how it was developed.

In this section you will use these words.

- measurement
- unit of measurement
- standard system of measurement
- Imperial system of measurement
- metric system of measurement

Working Together

Measurement is the process of comparing something to a measuring tool to find out how many measuring units there are.

The Introductory Activities are designed to make you aware of the need for a standard system of measurement.

The notes and activities that follow will reinforce the idea that the units of measurement have changed over the centuries.

Introductory Activities

Space for Your Work

1. Pretend you do not have any modern measuring instruments and you do not know a system of measurement. How would you describe the length of the following?

   a. this booklet

   b. a paper clip

2. People sometimes use informal language to describe measurement. What do the following phrases mean?

   a. a stone's throw away

   b. a pinch of salt

   c. seven paces wide

   d. in the wink of an eye

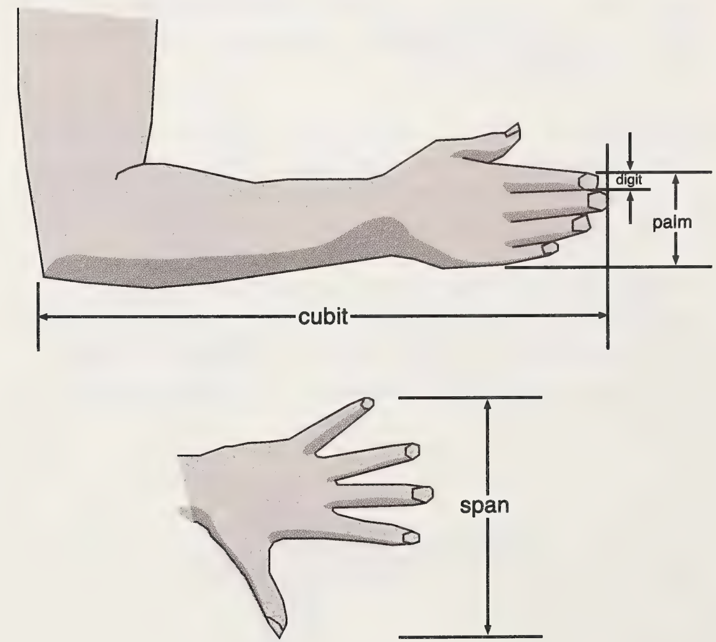
3. List 5 examples in everyday life when more formal measurement is important.

✓ See your learning facilitator to check your answers and to receive further instructions.

Early Units of Measure

The first units of measurement were units of length. The notes in this section explain how the units of length developed. In the Practice Activities that follow you will learn about the development of mass and capacity units.

The ancient Egyptians, Hebrews, Greeks, and Romans all used the human body as a basis of measuring lengths. Look at the illustration to the right.



Below is a chart which shows the relationship between the units of length that the Hebrews used. (You are not expected to memorize these.)

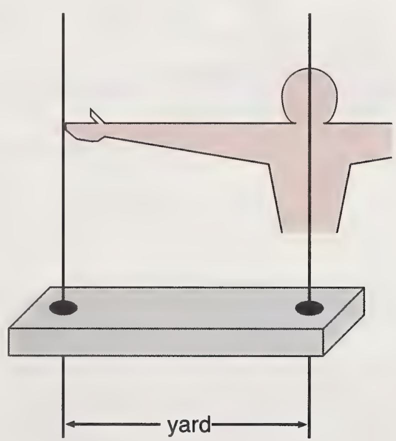
Multiplier		Unit	Translation
		1 ezba	digit (finger)
4 ezba	=	1 tefah	palm
3 tefah	=	1 zeret	span
2 zeret	=	1 ammah	cubit

Imperial Units

The British developed a system of measurement called the **Imperial System**. The basic unit of length in this system is the yard.

Legend has it that the yard was originally equivalent to the distance between the nose and the fingertips of the outstretched arm of King Henry I of England (1100-1135).

In 1855 the yard was redefined as the distance between two lines engraved on two gold plugs inlaid on a bronze bar at 62°F. (See the diagram below.) This was a more exact standard of measurement.



Below is a chart which shows the relationship between the Imperial units of measurement. (You are not expected to remember these relationships.)

Multiplier	Unit
$\frac{1}{36}$ yard	= 1 inch
$\frac{1}{3}$ yard	= 1 foot
	yard
$5\frac{1}{2}$ yards	= 1 rod, pole or perch
220 yards	= 1 furlong
1760 yards	= 1 mile

Metric Units

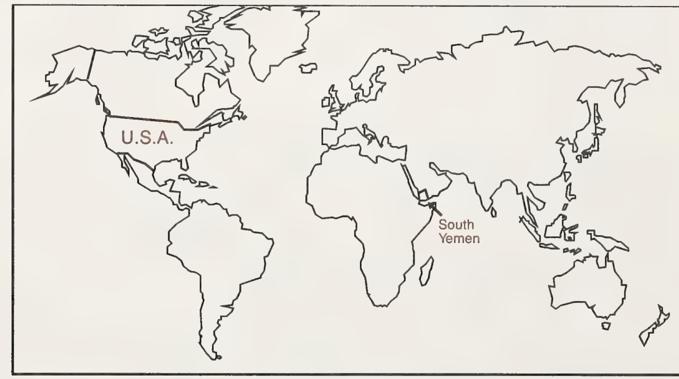
In the 1700's scientists began trying to develop a better system of measurement, one that would be easy to use and could be shared by most nations of the world. The **metric system** was developed as a result.

The basic unit of length in this system is the metre. The following chart shows how the units are related.

Multiplier	Unit
0.001 metre	= 1 millimetre
0.01 metre	= 1 centimetre
0.1 metre	= 1 decimetre
	metre
10 metres	= 1 decametre
100 metres	= 1 hectometre
1000 metres	= 1 kilometre

You will learn more about these metric units for length in Section 3.

Today most of the world uses the metric system. The United States and South Yemen are the only nations that are non-metric.



Practice Activities

1. Use the old Hebrew units of length to do the following. Have your learning facilitator also do these activities.

a.	length of table top in cubits
b.	width of this paper in digits (fingers)
c.	width of this paper in palms
d.	width of the door in spans
e.	length of table top in spans

2. Compare your measurements and those of your learning facilitator.

   a. Are the measurements the same? If not, explain why.

   b. Would you say that using body parts as units of measurement is an accurate way to record measures? Why or why not?

Space for Your Work

	Your Measurements	Learning Facilitator's Measurements
a.		
b.		
c.		
d.		
e.		

Space for Your Work

3. Why do you think the British redefined the yard in 1855?

4. Explain why the metric system is often said to be easier to use.

See your learning facilitator to check your answers and to receive further instructions.

Concluding Activities

Space for Your Work

The following activities may require research work in the library or home.

1. What are some of the units of mass in the British or Imperial system?

2. What is the basic unit of mass in the metric system?

3. In the British or Imperial system there are different unts for measuring capacity of dry ingredients and liquids. What are they?

4. What is the basic unit of capacity in the metric system?

5. How are the units of capacity, mass, and length in the metric system similar?

See your learning facilitator to check your answers and to receive further instructions.

PRECISION AND ESTIMATION IN MEASURING

What Lies Ahead

In this section you will learn that all measurements are estimates. The precision of the measurement depends on the tool you use and how well you use it.

In this section you will use these words.

- precision
- estimation

Working Together

Many measuring tools have been invented. You will find examples on the following pages.

Tools to Measure Length

The illustrations on this page show examples of tools used to measure length: how long, wide, or high objects are.

A. A metre stick is used to measure straight lines.

B. A measuring tape is used to measure curved surfaces.

C. A trundle wheel is used to measure longer distances.

D. A deep guage is used to measure the internal depth of a container.

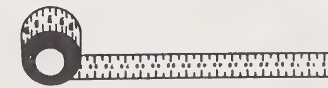
E. A diameter guage is used to measure the internal diameter of a container.

F. A micrometer is used to measure small objects more precisely.

G. An odometer (not shown) is used to measure very long distances.

A.

B.



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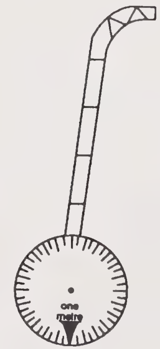

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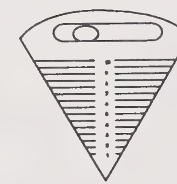

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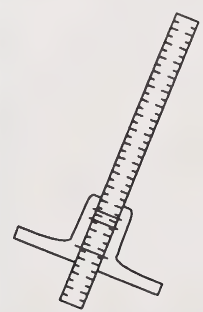

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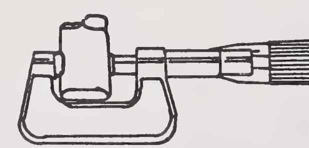


Tools to Measure Mass

The illustrations on this page show examples of tools used to measure mass: the amount of matter in an object.

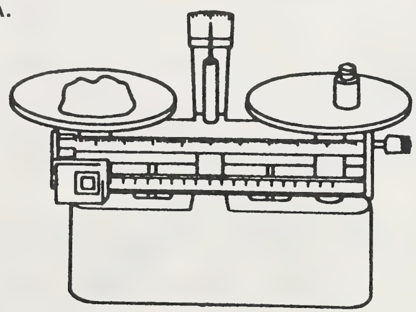
A. A double-pan balance is used in science laboratories to measure solids and liquids.

B. Spring balances are also used in science.

C. A bathroom scale is used to determine a person's body mass or weight.

D. A single-pan balance is used in kitchens to measure mass.

A.



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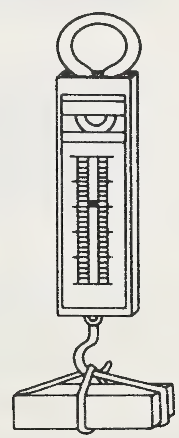

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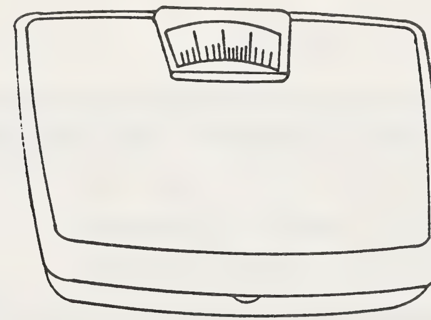

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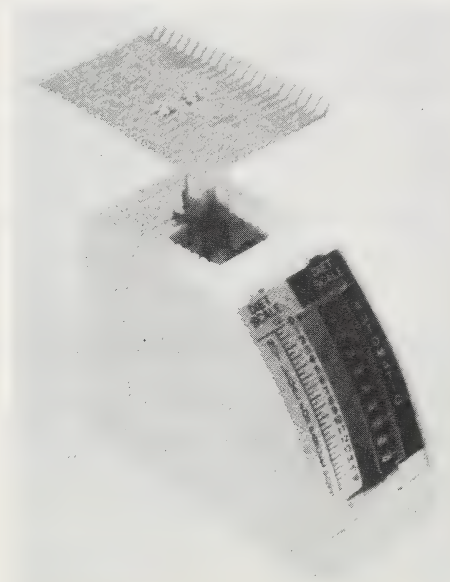

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Tools to Measure Capacity

The illustrations on this page show examples of tools used to measure capacity: the amount an object will hold.

A. Measuring cups are used in the home for measuring liquids (milk, water) for baking.

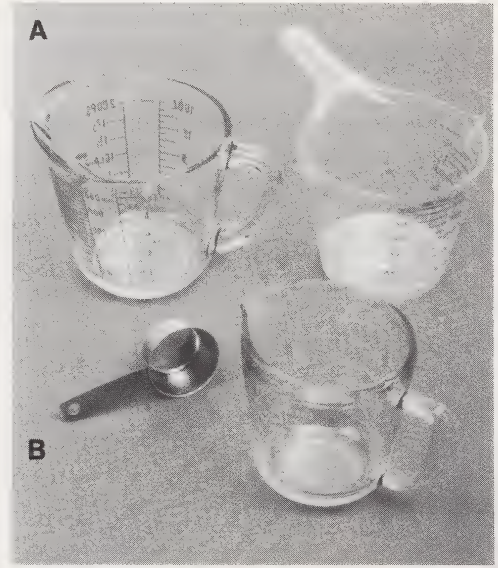
B. Measuring cups are used in the home for measuring dry quantities (sugar, flour) for baking.

C. Measuring spoons are used in homes for measuring spices for baking.

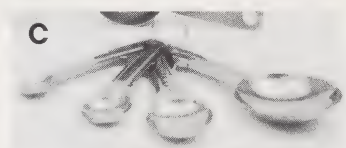
D. A beaker is used in science laboratories for measuring liquids.

E. A graduated cylinder is also used in science laboratories for measuring liquids.

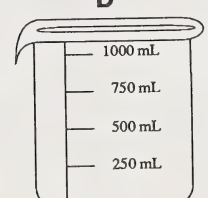
F. A syringe is used in hospitals for measuring medicine to be injected.



WESTFILE INC.

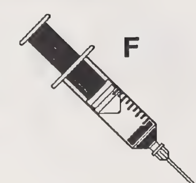


D



E

F



Video Activity

View the program *SOLVE IT: Precision and Estimation*. Watch for the difficulties the characters encounter when they try to measure precisely. Also note the different types of measuring instruments they use.

If you cannot watch the video program, read the following summary. The program has 2 stories and 1 real-life application.

Program Summary

Story #1

Tamika and Ginger are runners. They want to measure how fast they can run. They decide to pace off 100 m and to measure, with a stop watch, the time it takes each girl to run this distance.

Afterwards, they disagree about the accuracy of the distance they paced off and the precision with which they used the stop watch.

Story #2

Chip and Duane are making peanut brittle. The recipe indicates the temperature of the candy must rise 60°. However, their only thermometer, a meat thermometer, does not reach the temperature they need for the peanut brittle.

They consider measuring the time it takes the temperature of the candy to rise 30° and doubling this time. They realize this won't work as the temperature does not rise at a constant rate.

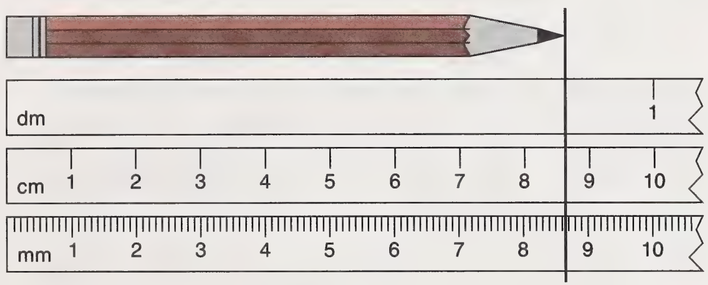
Fortunately, the recipe explains another method to discover when the candy has reached the required temperature. They test the candy by dropping a bit of it into ice water. When the bit of candy separates into hard brittle threads in the water, the candy is done.

Real-Life Application

A representative from the ceramics industry explains about various tools used in this industry.

Most measuring tools have scales with subdivisions. When you measure, you must compare the object to the scale and decide to which subdivision on the scale the object is closest. The accuracy of the measurement depends on the tool you use and how well you use it.

Some rulers, for example, may be divided into decimetres. Others are divided into centimetres. Others are divided into millimetres.

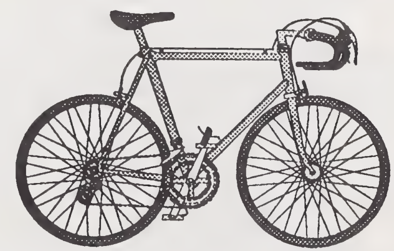


The pencil's length can be read on each scale.

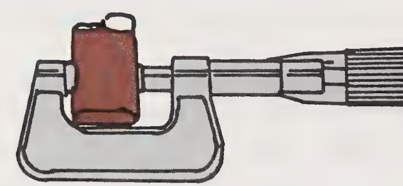
- 0.9 cm
- 8.7 cm
- 86.5 mm

All the measurements are estimates, but the smaller the divisions on the scale, the more accurate the measurement.

Not all situations require the same degree of precision. For example, if you wish to measure the distance you travel on a bike, you could use an odometer and measure the distance to the nearest kilometer.



If you wished to measure the width of a lighter, you could use a micrometer and measure its diameter to the nearest millimetre.



Practice Activities

Space for Your Work

1. In the video (or video summary) you learned that the two girls paced out a distance of 100 m and then used a stopwatch to time how fast they ran that distance. What are some reasons their times might not be accurate?

2. What characteristics of a measuring instrument determines how precisely it measures?

3. What instrument would you use to measure in each of the following situations?

   a. distance on a bike hike

   b. thickness of a piece of paper

   c. how fast a race is run

   d. length of a football field

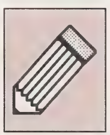
   e. height of a basketball player

4. Can you ever measure absolutely accurately? Why or why not?

Computer Alternative

5. Do "Scales" on the *Mathematics for Science: Measurement* disk.

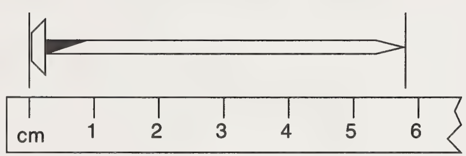
Print Alternative



6. Give the length of each object in centimetres.

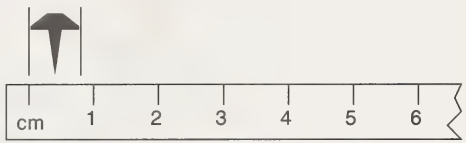
a.

b.

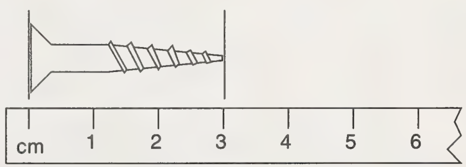


Space for Your Work

c.



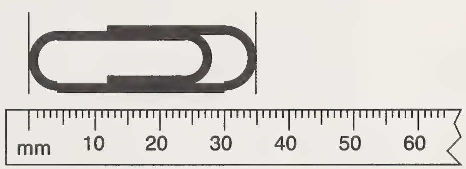
d.



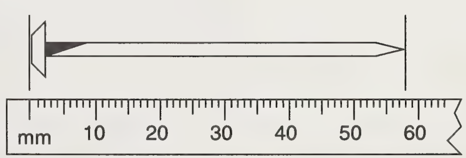
Space for Your Work

7. Give the length of each object in millimetres.

a.

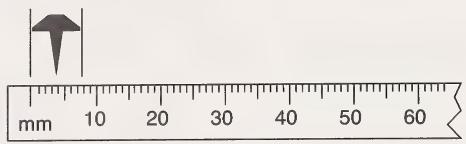


b.

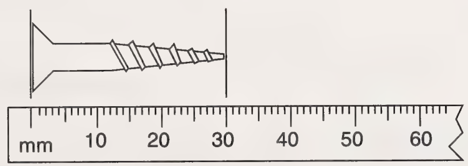


Space for Your Work

c.



d.



See your learning facilitator to check your answers and to receive further instructions.

MEASURING LENGTH

What Lies Ahead

In this section you will learn these skills.

- estimating the length of objects
- measuring the length of objects

In this section you will learn these words.

- millimetre
- centimetre
- decimetre
- metre
- decametre
- hectometre
- kilometre
- length
- width
- height
- depth
- thickness

Working Together

In this section you will be dealing with length — finding how long, wide, or high objects are.

To prepare yourself for this section you should review the linear units which are in the metric system.

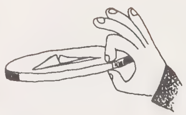
The basic unit of length in the metric system is the metre. The following chart shows how the units are related.

Multiplier	Unit
0.001 metre	= 1 millimetre
0.01 metre	= 1 centimetre
0.1 metre	= 1 decimetre
	metre
10 metres	= 1 decametre
100 metres	= 1 hectometre
1000 metres	= 1 kilometre

The next page shows the most commonly used units.

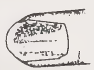
Commonly-Used Units of Length

mm (millimetre)



The thickness of a dime is about **1 mm**.

cm (centimetre)



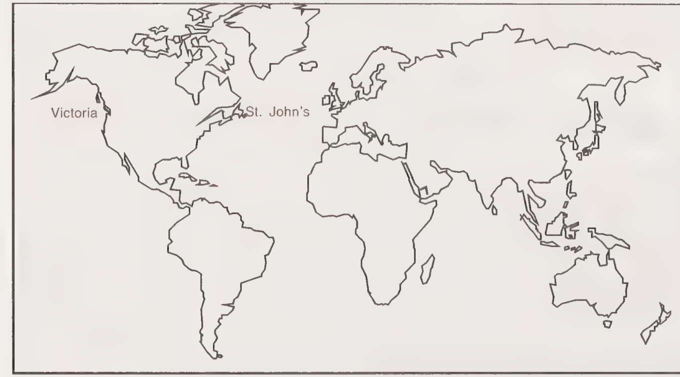
The widest part of your little fingernail is about **1 cm** wide.

1 cm = 10 mm

m (metre)

A door opening is about **2 m** high. A door knob is approximately **1 m** from the floor;

1 m = 100 cm



km (kilometre)

Kilometres are used to measure longer distances. A total of **7605 km** is the distance from St. John's, Nfld. to Victoria, B.C.

1 km = 1000 m

In the practice activities you will be practicing the selecting of appropriate linear units. You will also be estimating how long objects are and measuring objects.

Practice Activities

Space for Your Work

1. What unit would be appropriate to measure the following?

   a. the distance from Edmonton to Calgary

   b. the height of a mountain

   c. the length of a stamp

   d. the thickness of a dime

   e. the thickness of a 250-page book

   f. the length of a car

   g. your height

   h. the length of your house

   i. the depth of a river

   j. the thickness of the lead in your pencil

2. Circle the most reasonable measure.

a. height of a basketball hoop

b. height of a bike

c. height of football posts

d. height of a bowling pin

e. length of a bowling alley

f. length of a hockey stick

g. length of a baseball bat

h. length of a canoe

Space for Your Work

2. a.	300 mm	300 cm	300 m	300 km
b.	99 mm	99 cm	99 m	99 km
c.	6 mm	6 cm	6 m	6 km
d.	38 mm	38 cm	38 m	38 km
e.	18 mm	18 cm	18 m	18 km
f.	138 mm	138 cm	138 m	138 km
g.	1 mm	1 cm	1 m	1 km
h.	4 mm	4 cm	4 m	4 km

i. width of a paper clip

j. width of a bookcase

k. width of a chair

l. width of a house

m. distance from Vancouver to Victoria

n. diameter of a pea

Space for Your Work

i.	8 mm	8 cm	8 m	8 km
j.	40 mm	40 cm	40 m	40 km
k.	53 mm	53 cm	53 m	53 km
l.	10 mm	10 cm	10 m	10 km
m.	100 mm	100 cm	100 m	100 km
n.	5 mm	5 cm	5 m	5 km

See your learning facilitator to check your answers and to receive further instructions.

Concluding Activities

Space for Your Work

1. Estimate the following.

   a. the length of your foot

   b. the width of your fingernail

   c. the circumference of your waist

   d. the length of a pair of scissors

   e. the width of a paper clip

   f. the length of a pencil

   g. the width of the lead in your pencil

   h. the height of your room

   i. the height of a door

2. a. Use a metre stick, ruler, or tape measure to find the measures of the items in Question 1.

   b. How close were your estimates?

3. Use a piece of paper and a straightedge, but not a ruler, to draw line segments that you think are these lengths.

   a. 5 mm

   b. 6 cm

   c. 7 cm

   d. 50 mm

4. a. Measure the line segments you drew in Question 3 with a metric ruler.

   b. How close were you?

5. Use a straightedge, but not a metre stick or measuring tape, to draw the line segments of the following length on the floor or sidewalk with chalk.

   a. 1 m

   b. 2 m

   c. 5 m

   d. 3.75 m

Space for Your Work

Space for Your Work

6. a. Use a metre stick, measuring tape, or trundle wheel to measure the length of the segments you drew in Question 5.

   b. How close were you?

7. Pick a starting point on a street and walk until you think the distance from the starting point is 1 km.

8. a. Have someone measure the distance you walked with the odometer on a car.

   b. How close were you?

See your learning facilitator to check your answers and to receive further instructions.

MEASURING MASS

What Lies Ahead

In this section you will learn these skills.

- estimating the mass of an object
- measuring the mass of an object

In this section you will learn these words.

- mass
- milligram
- centigram
- decigram
- gram
- decagram
- hectogram
- kilogram

Working Together

In this section you will be dealing with mass. The mass of an object is the amount of matter in the object.

To prepare yourself for this section you should review the mass units which are in the metric system.

The basic unit of mass in the metric system is the gram. The following chart shows how the units are related.

Multiplier	Unit
0.001 gram	= 1 milligram
0.01 gram	= 1 centigram
0.1 gram	= 1 decigram
	gram
10 grams	= 1 decagram
100 grams	= 1 hectogram
1000 grams	= 1 kilogram

Note: 1000 kilograms = 1 tonne

The most commonly used units are on the next page.

Commonly-Used Units of Mass

mg (milligram)

The symbol **mg** is found on prescription drugs. About **380 mg** is the mass of a common headache tablet.

g (gram)

Many foods are sold in packages measured in grams, such as the **500 g** package of potato chips. A small button, a raisin, and a paper clip each have a mass of 1 g. A nickel has a mass of about 5 g.

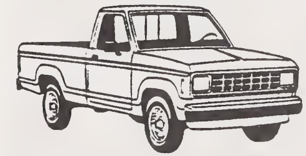
1 g = 1000 mg

kg (kilogram)

Another useful unit for mass is the kilogram. Packages of **2 kg** and **4 kg** are common sizes for sugar.

1 kg = 1000 g

1 (tonne)



In measuring larger masses, tonnes are used. A mass of **1 t** is what a van or pickup could carry.

1 t = 1000 kg

In the Practice Activities you will be practicing the selection of appropriate units of mass. You will also be estimating the mass of objects and measuring the mass of objects.

Practice Activities

Space for Your Work

1. Which unit would you use to describe each of the following masses?

   a. a whale

   b. a cat

   c. a person

   d. a tropical fish

   e. a pencil

   f. riboflavin (vitamin B_2) in cereal

   g. a television

   h. a plane

2. Circle the most reasonable measure.

a. a carrot

b. a cat

c. an elephant

d. a person

e. a penny

f. a stamp

g. a railway car

h. a blueberry

i. a headache tablet

See your learning facilitator to check your answers and to receive further instructions.

Space for Your Work

2. a.	50 mg	50 g	50 kg	50 t
b.	3 mg	3 g	3 kg	3 t
c.	5 mg	5 g	5 kg	5 t
d.	50 mg	50 g	50 kg	50 t
e.	2 mg	2 g	2 kg	2 t
f.	20 mg	20 g	20 kg	20 t
g.	60 mg	60 g	60 kg	60 t
h.	500 mg	500 g	500 kg	500 t
i.	350 mg	350 g	350 kg	350 t

Concluding Activities

Space for Your Work

Do **one** from Questions 1 to 3.

1. a. Visit a supermarket and estimate the mass of several items of produce (such as the ones in the following list). Then use the scales to check your estimates.

   - a lemon
   - a green pepper
   - a package of carrots
   - a bag of potatoes
   - a pea pod
   - an apple
   - an avocado
   - a strawberry
   - a head of lettuce
   - a bunch of bananas

   b. Fill a bag with produce until you think the bag weighs 1 kg. Check the mass on the scales.

Space for Your Work

2. a. Visit a school laboratory and estimate the masses of several items (such as the ones in the following list). Then use the scales to check your estimates.

    - a paper clip
    - a matchbook
    - a textbook
    - a pair of scissors
    - a stapler
    - a shoe
    - a sheet of paper
    - a protractor
    - a glue stick
    - a rubber band

   b. Fill a bag with objects until you think the bag weighs one kilogram. Check the mass on the scales.

3. Have your learning facilitator assemble several items that have labels with the mass of the object on it (example: a bag of flour, a roast of beef, a package of cereal, a glue stick). Estimate the mass of each item. Then check the labels.

See your learning facilitator to check your answers and to receive further instructions.

MEASURING CAPACITY

What Lies Ahead

In this section you will learn these skills.

- estimating the capacity of an object
- measuring the capacity of an object

In this section you will learn these words.

- capacity
- millilitre
- centilitre
- decilitre
- litre
- decalitre
- hectolitre
- kilolitre

Working Together

In this section you will be dealing with capacity. The capacity of an object is the amount a container will hold.

To prepare yourself for this section you should review the capacity units which are in the metric system.

The basic unit of capacity in the metric system is the litre. The following chart shows how the units are related.

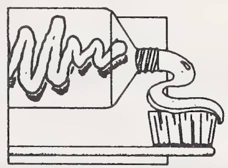
Multiplier	Unit
0.001 litre	= 1 millilitre
0.01 litre	= 1 centilitre
0.1 litre	= 1 decilitre
	litre
10 litres	= 1 decalitre
100 litres	= 1 hectolitre
1000 litres	= 1 kilolitre

The most commonly used units are on the next page.

Commonly-Used Units of Capacity

mL (millilitre)

Toothpaste tubes holding **50**, **100**, or **150 mL** are examples of some articles sold in millilitres.



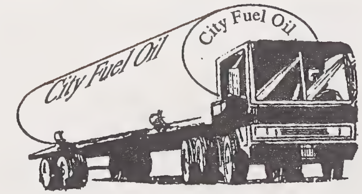
A teaspoon holds about **4 mL**. A soup spoon holds about **15 mL**.

L (litre)

Many products such as gasoline, paint, and cooking oils are sold in litres. Milk is sold in **1-L** and **2-L** containers.

1 L = 1000 mL

kL (kilolitre)



Kilolitres are used to measure larger capacities. The capacity of tank trucks are measured in kilolitres.

1 kL = 1000 L

In the Practice Activities you will be practicing the selection of appropriate units of capacity. You will also be estimating the capacity of containers and measuring the capacity of containers.

Practice Activities

Space for Your Work

1. Which unit would you use to describe the capacity of the following?

   a. an eye dropper

   b. a jelly jar

   c. a soup spoon

   d. a dessert bowl

   e. a drinking glass

   f. a bath tub

   g. a swimming pool

   h. a mixing bowl

   i. a picnic jug

   j. a washing machine

2. Circle the most reasonable measure.

a. a can of paint

b. a shampoo bottle

c. a bottle of liquid paper

d. a carton of milk

e. a water barrel

3. Arrange the following units from smallest to largest.

250 mL, 1200 mL, 1 L, 25 L, 0.3 KL

See your learning facilitator to check your answers and to receive further instructions.

Space for Your Work

2. a. 5 mL 5 L

b. 750 mL 750 L

c. 18 mL 18 L

d. 2 mL 2 L

e. 15 mL 15 L

Concluding Activities

Space for Your Work

Do **one** from Questions 1 and 2.

1. Borrow metric measuring cups and spoons from the home economics class or your kitchen. Fill empty containers such as the following with water and estimate the capacity of each. Then measure the amount of water each holds.

    a. a bottle cap

    b. a drinking glass

    c. a cereal bowl

    d. a mixing bowl

    e. a can

    f. a pop bottle

    g. a jar

Space for Your Work

2. Have your learning facilitator assemble several items that have labels with the capacity on them (for example: a can of soup, a can of juice, a bottle of jelly, a tube of toothpaste, a can of paint).

   Estimate the capacity of each item. Then check the labels.

See your learning facilitator to check your answers and to receive further instructions.

MEASURING PERIMETER

What Lies Ahead

In this section you will learn these skills.

- finding the perimeter of a figure

In this section you will learn these words.

- perimeter
- sketch
- side
- matching marks

Working Together

Perimeter is the distance around a figure. Perimeter is a measurement of length.

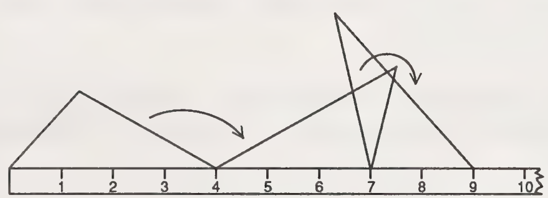
Finding the perimeter of an object is a useful skill for everyday life. For example, to find how much wood you need to fence your property, you need to find the perimeter.

In the Introductory Activities you will find the perimeter of figures which you will cut out several objects.

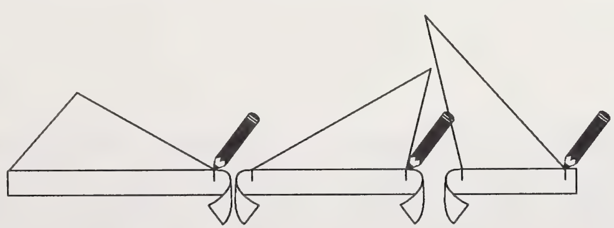
Introductory Activities

1. Cut out the figures labelled "Section 7 Figures" in the appendix. Then do one or more of the following to find the perimeter of each figure. Record the perimeter of each figure on the figure.

   a. Find the perimeter of the figures by "rolling" the figure along a metric ruler or metre stick.



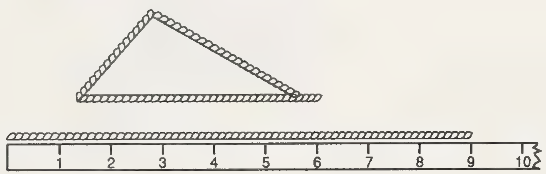
   b. Use a strip of paper to help you find the perimeter of each figure. Then measure the strips of paper and find the sum.



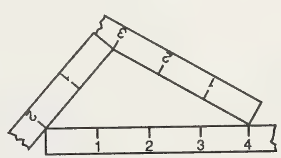
Space for Your Work

Space for Your Work

c. Use string to help you find the perimeter of each figure. Then measure the string.



d. Measure each side of a figure and find the sum.



Space for Your Work

2. Find the perimeter of the following.

   a. your booklet

   b. your desk

   c. your room

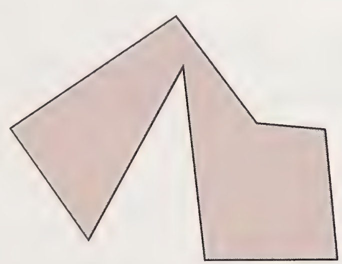
   d. your waist

   e. your ring finger

   f. the sole of your shoe

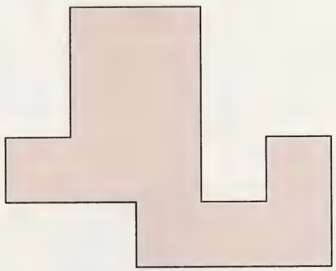
3. Measure the length of the sides of each figure and find the perimeter.

   a.



Space for Your Work

b.



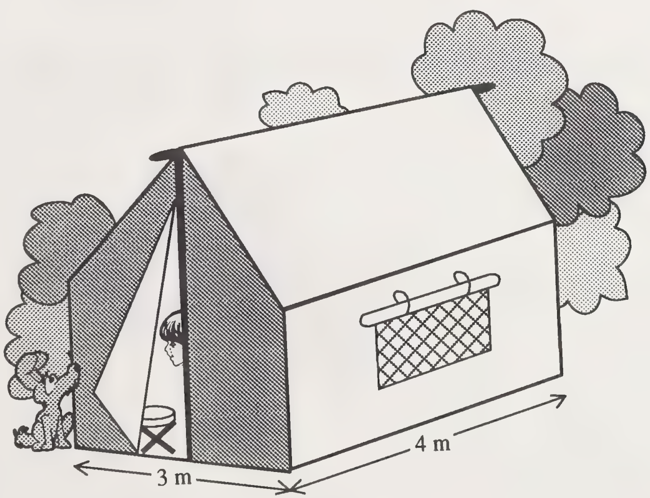
See your learning facilitator to check your answers and to receive further instructions.

Working Together

In the Introductory Activities you actually measured the figures yourself. Often you will be given measurements of a figure and you will be asked to find the perimeter.

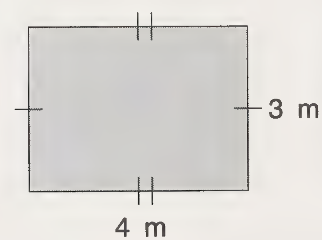
Example

Find the perimeter of the tent floor.



Solution

Make a sketch of the floor.



Matching marks indicate equal sides.

Find the perimeter.

3 m + 3 m + 4 m + 4 m = 14 m

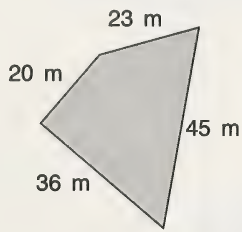
The perimeter of the tent floor is 14 m.

Practice Activities

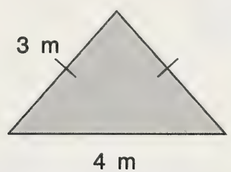
Space for Your Work

1. Give the perimeters of the sketches. (A sketch is not drawn to scale.)

a.

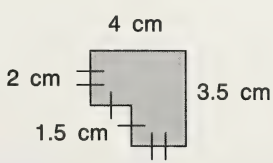


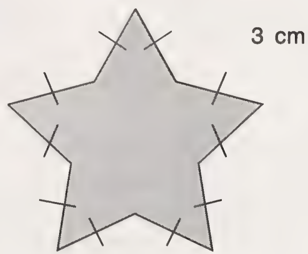
b.



Matching marks indicate the same measure.

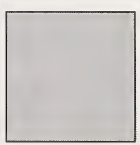
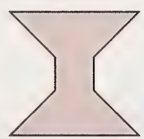
c.

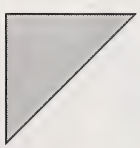
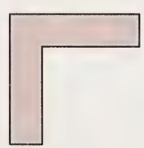


d. 

Space for Your Work

2. Which has the greater perimeter?

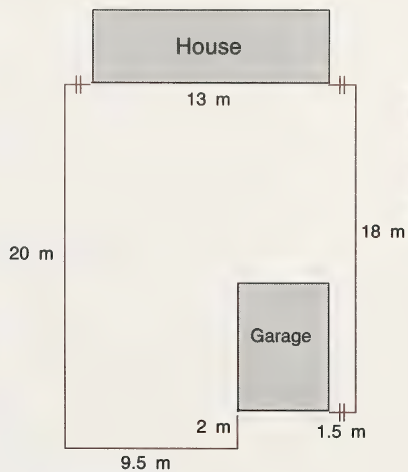
a.  OR 

b.  OR 

c.  OR 

Space for Your Work

3. Al Yarmalay wants to fence his back yard.



Matching marks indicate the same measure.

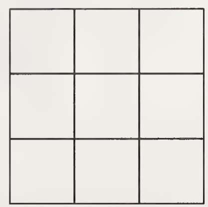
What is the perimeter of the region to be fenced?

See your learning facilitator to check your answers and to receive further instructions.

Concluding Activities

Space for Your Work

1. Cut out 9 1-cm squares from the 1-cm grid paper in the appendix the booklet. Arrange them in a 3-cm by 3-cm array.



   a. What is the perimeter?

   b. Show how you can remove 4 squares without affecting the perimeter.

2. Use 4 of the squares to form a figure with a perimeter of

   a. 8 cm

Space for Your Work

b. 10 cm

c. 12 cm

d. 14 cm

e. 16 cm

See your learning facilitator to check your answers and to receive further instructions.

MEASURING AREA

What Lies Ahead

In this section you will learn these skills.

- measuring the area of figures using grid paper
- estimating the area of figures

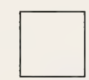
In this section you will learn these words.

- linear unit
- square unit
- square millimetre
- square centimetre
- square decimetre
- square metre
- square decametre
- square hectometre
- square kilometre

Working Together

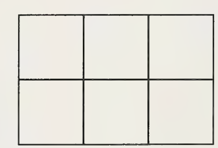
Area is used in many everyday situations such as buying carpet for your livingroum or sod for your lawn.

Area is a measurement of the surface. Square units are used to measure area.



square unit

Example



The area of the rectangle is 6 square units.

Introductory Activities

Space for Your Work

1. Find the area of the following shapes by counting the square units.

   a. 

   b. 

   c. 

Space for Your Work

d. 

2. Find the areas of the following figures by counting the square units. Part a is done as an example.

a. 

2. a. 

$$1 + 1 + 1 + \frac{1}{2} + \frac{1}{2} + \frac{1}{2} = 4\frac{1}{2}$$

There are **3** whole squares (x) and **3** half squares (✓). So the area is $4\frac{1}{2}$ square units.

Space for Your Work

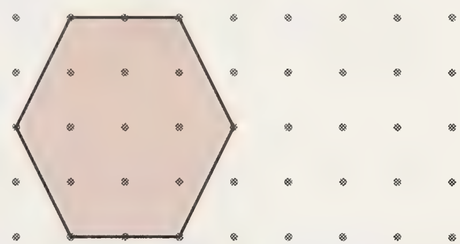
b.

c.

d.

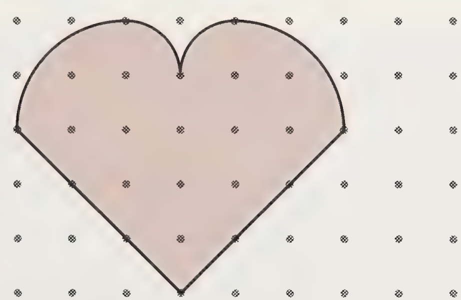
e.

f.



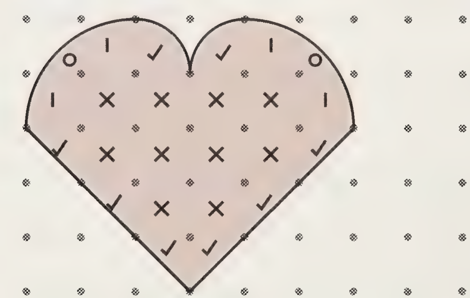
3. Find the area of the following figures by counting the square units. a is done as an example.

a.



Space for Your Work

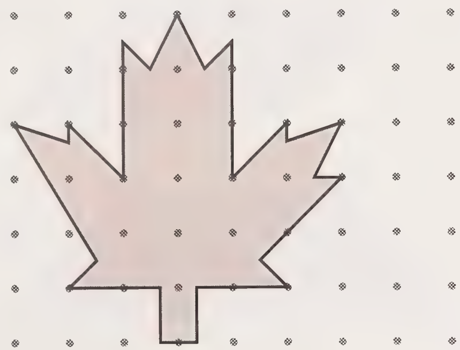
3. a.



There are **10** whole squares (×).	10
There are **8** half squares (✓).	4
There are **2** regions that are closer to zero square units (○).	0
There are **4** regions that are closer to one square unit (ı).	4
	18

So the area is about 18 square units.

b.



Space for Your Work

See your learning facilitator to check your answers and to receive further instructions.

Working Together

Metric Units for Area

The units of area used in the metric system are derived from the units of length. For example, 1 square centimetre is a square with sides 1 centimetre in length.

The following chart shows how the units are related.

Multiplier	Unit
	1 square millimetre (mm^2)
100 mm^2	= 1 square centimetre (cm^2)
100 cm^2	= 1 square decimetre (dm^2)
100 dm^2	= 1 square metre (m^2)
100 m^2	= 1 square decametre (dam^2)
100 dam^2	= 1 square hectometre (hm^2)
100 hm^2	= 1 square kilometre (km^2)

Commonly Used Units of Area

cm^2 The key top of a touch-tone telephone has an area of 1 cm^2. The round holes in the dial-type of telephone also have an area of 1 cm^2.

m^2 Two full sheets of *The Edmonton Journal* or *Calgary Herald* cover an area of about 1 m^2.

hm^2 The field inside an Olympic track would cover an area of 1 hm^2.

km^2 Thirty city blocks would cover about 1 km^2.

Note

1 square hectometre (hm^2) is also called 1 hectare (1 ha).

In the Practice Activities you will be selecting the appropriate unit of area. You will also be estimating the area of regions and measuring the regions using grid paper.

Practice Activities

Space for Your Work

1. Which unit would you use for the area of each of the following?

   a. a desk top

   b. this page

   c. the livingroom floor

   d. a provincial park

   e. a parking lot

   f. a stamp

2. Circle the most reasonable measure for the area of the following.

   a. Toronto

   b. the field inside an Olympic track

   c. a card table cover

2. a.	620 cm^2	620 m^2	620 ha	620 km^2
b.	1 cm^2	1 m^2	1 ha	1 km^2
c.	0.6 cm^2	0.6 m^2	0.6 ha	0.6 km^2

Space for Your Work

d. a computer disk

e. a wallet photograph

f. the top of a videocassette

d. 169 cm^2 169 m^2 169 ha 169 km^2

e. 40 cm^2 40 m^2 40 ha 40 km^2

f. 230 cm^2 230 m^2 230 ha 230 km^2

3. Arrange the following areas from least to greatest.

   3 ha, 198 cm^2, 1 m^2, 103 km^2

See your learning facilitator to check your answers and to receive further instructions.

Concluding Activities

Space for Your Work

1. Collect several small objects from your house or classroom.

   First estimate the area each object will cover.

   Then use the 1-cm grid paper in the appendix of this booklet to check your estimates. (Lay the objects on the grid paper and trace them. Then count the squares.)

2. Two full **sheets** of *The Edmonton Journal* and *Calgary Herald* cover approximately 1 m^2.

   Use sheets of newspaper to cover the following areas.

   a. 1 m^2

   b. 2 m^2

   c. 3 m^2

3. Estimate the area of the livingroom floor in your house (or the classroom floor in your school).

See your learning facilitator to check your answers and to receive further instructions.

MEASURING VOLUME

What Lies Ahead

In this section you will learn these skills.

- interpreting volume
- finding the volume of a rectangular solid by counting cubes
- estimating volumes of rectangular solids

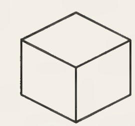
In this section you will learn these words.

- volume
- cubic unit
- cubic millimetre
- cubic centimetre
- cubic decimetre
- cubic metre
- cubic decametre
- cubic hectometre
- cubic kilometre

Working Together

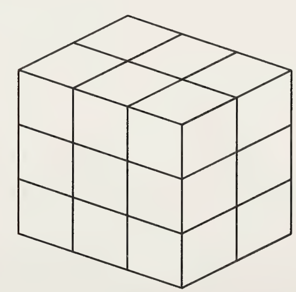
Volume is a measurement of how much space an object occupies.

You can find volume by counting cubes.



1 cubic unit

Example



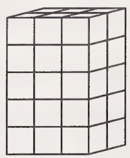
Some cubic units are hidden.

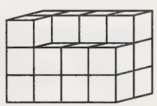
The rectangular solid has 18 cubic units.

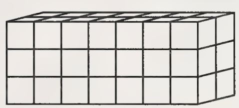
Introductory Activities

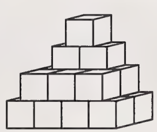
Space for Your Work

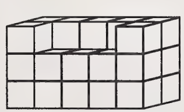
1. Construct the following with units from the base 10 Blocks. Then count the units to find the volume.

   a. 

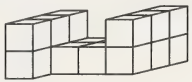
   b. 

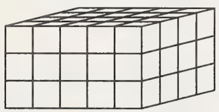
   c. 

   d. 

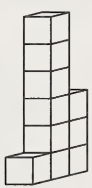
   e. 

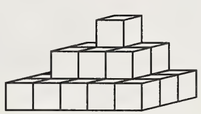
Space for Your Work

f. 

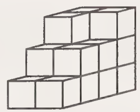
g. 

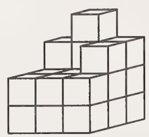
2. Find the volumes by counting cubes in the diagrams. Remember the hidden cubes.

a. 

b. 

Space for Your Work

c. 

d. 

See your learning facilitator to check your answers and to receive further instructions.

Working Together

Metric Units of Volume

The units of volume used in the metric system are derived from the units of length. A cubic centimetre has length, height, and width of 1 centimetre.

The following chart shows how the units are related.

Multiplier	Unit
	1 cubic millimetre (mm^3)
1000 mm^3	= 1 cubic centimetre (cm^3)
1000 cm^3	= 1 cubic decimetre (dm^3)
1000 dm^3	= 1 cubic metre (m^3)
1000 m^3	= 1 cubic decametre (dam^3)
1000 dam^3	= 1 cubic hectometre (hm^3)
100 hm^3	= 1 cubic kilometre (km^3)

Commonly Used Units of Volume

cm^3 A marble has a volume of 1 cm^3.

dm^3 A brick has a volume of 1 dm^3.

m^3 A refrigerator packing crate has a volume of 1 m^3.

In the Practice Activities you will be selecting the appropriate unit of volume. You will also be estimating the volume of objects using base 10 blocks.

Practice Activities

Space for Your Work

1. What unit would you use for the volume of each of the following?

   a. a camper

   b. a walnut

   c. a freezer

   d. a suitcase

2. Circle the most reasonable measure.

   a. the volume of a tool chest

   b. the volume of an aquarium

   c. the volume of a livingroom

2\. a. $57.6\ cm^3$ $576\ cm^3$ $5760\ cm^3$

b. $72\ cm^3$ $720\ cm^3$ $7200\ cm^3$

c. $50\ m^3$ $500\ m^3$ $5000\ m^3$

d. the volume of a four-drawer filing cabinet

e. the volume of a softball

3. Arrange from smallest to largest.

   $0.6\ m^3$, $800\ cm^3$, $1200\ cm^3$, $9\ m^3$

See your learning facilitator to check your answers and to receive further instructions.

Space for Your Work

d. $0.4\ m^3$ $4\ m^3$ $40\ m^3$

e. $48\ cm^3$ $480\ cm^3$ $4800\ cm^3$

Concluding Activities

Space for Your Work

Gather several small boxes from around the house (or school).

Estimate the volume of each box.

Check your estimates by doing **one** of the following.

- Arrange the units (smallest pieces of base 10 blocks) in the box. Count the number of units. Each unit is 1 cm^3.

OR

- Tape 1-cm grid paper to the outside faces of the box. Determine the number of cm^3 the box will hold. There is 1-cm grid paper in the appendix of this booklet.

See your learning facilitator to check your answers and to receive further instructions.

RELATING VOLUME AND CAPACITY

What Lies Ahead

In this section you will learn how volume and capacity are related in the metric system.

In this section you will learn these words.

- cubes
- rectangular solid
- three dimensional

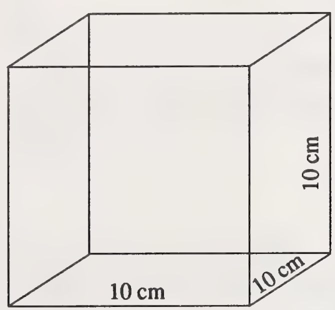
Working Together

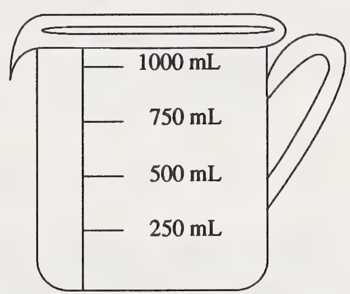
In this section you will learn about the relationship between volume and capacity.

This section is optional. It is included for enrichment purposes only.

Introductory Activities

For this investigation you will need a 1-dm^3 cube, a 1-L measuring cup, and some rice or other dry ingredients.





If you do not have a 1-dm^3 cube you can make one by taping together 5 pieces of cardboard that are each 1 dm^2 (10 cm by 10 cm).

If you do not have a 1-L measuring cup, use an empty 1-L milk carton.

Space for Your Work

1. Fill the measuring cup with 1 L of rice (or some other dry ingredient).

2. Empty the measuring cup into the 1-dm^3 cube.

3. How do the capacities of the measuring cup and the box compare?

See your learning facilitator to check your answers and to receive further instructions.

Working Together

How Volume and Capacity are Related

As you learned from the Introductory Activities, capacity and volume are closely related.

The box occupies 1000 cm^3 of space. The volume of the box is 1000 cm^3. See Figure 1.

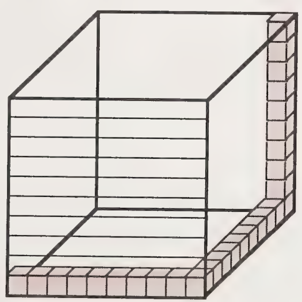


Figure 1

It also holds 1000 mL. The capacity of the box is 1000 mL, or 1 L. See Figure 2.

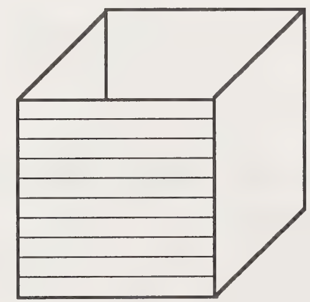


Figure 2

This relationship is summarized in the following chart.

Volume	Capacity
1000 cm^3	1000 mL
1 cm^3	1 mL

In the Practice Activities you will use the relationship between capacity and volume to state the volume of objects.

Finding the Volume of Objects Which are not Rectangular Solids

As you learned in the previous section, it is easy to find the volume of a rectangular solid by counting the cubes.

It is more difficult to find the volume of other three-dimensional objects.

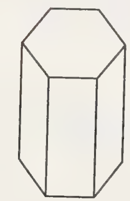
Video Activity

Watch the video program *SOLVE IT: Measuring Volume* to find a way to determine the volume of an object that is not a rectangular solid.

If you cannot watch the video, read the next column.

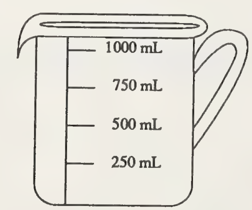
Example

Find the volume of the vase.



Solution

Fill the vase with water. Then measure the water that the vase holds.



The vase holds 800 mL.

$$1 \text{ mL} = 1 \text{ cm}^3$$

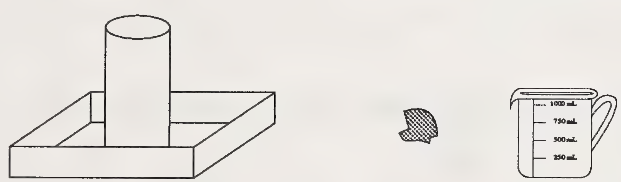
Hence it has a volume of about 800 cm^3.

Practice Activities

Space for Your Work

1. For this investigation you will need a pan, a container, a ball of modelling clay (or any other small solid object), water, and a metric measuring cup.

   a. Fill the container to the very top with water. Without spilling any water, place the container in the pan.



   b. Add the ball of modelling clay to the container.

Note: Some water will overflow into the pan.

Space for Your Work

c. Carefully remove the container from the pan. Do not spill any water.

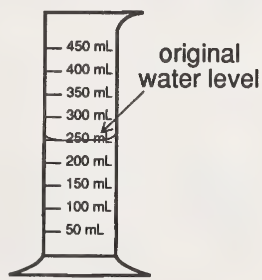
d. Pour the overflow water from the pan into the measuring cup.

e. Measure the amount of water in the measuring cup.

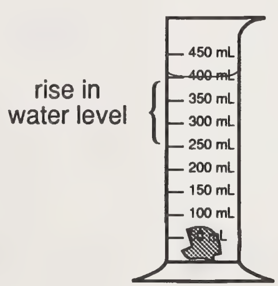
f. Calculate the volume of the modelling clay. (If the clay displaces 100 mL, the volume of the clay is 100 cm^3.)

2. If you have access to a graduated cylinder and some modelling clay, you may wish to try an investigation similar to the following.

   a. Fill a graduated container with water to the 250-mL mark.



   b. Carefully immerse the piece of modelling clay.



Space for Your Work

Space for Your Work

c. Calculate the rise in the water level.

The water level rises from the 250-mL mark to the 400-mL mark.

new water level	400 mL
− original water level	− 250 mL
rise in water level	150 mL

The modelling clay displaces 150 mL of water.

The modelling clay occupies 150 cm^3 of space in the container.

The volume of the modelling clay is 150 cm^3.

3. Obtain some small solid objects from around the house or school. Use the methods in Question 1 or 2 to find the volume of the objects.

See your learning facilitator to check your answers and to receive further instructions.

Concluding Activities

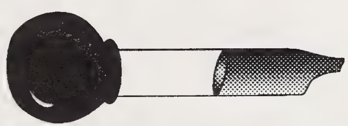
Space for Your Work

Write the volume of the following.

1.

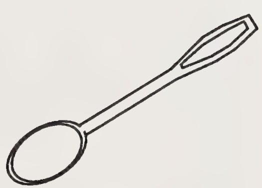
350 mL = ________ cm^3

2.



20 mL = ________ cm^3

3.



15 mL = ________ cm^3

4.

3 L = ________ cm^3

5.

2 L = ________ cm^3

Space for Your Work

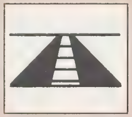
6.

6 kL = $\_\_\_\_\_\_$ m^3

Space for Your Work

See your learning facilitator to check your answers and to receive further instructions.

MEASURING ANGLES



What Lies Ahead

In this section you will learn these skills.

- measuring angles
- estimating angles
- naming angles

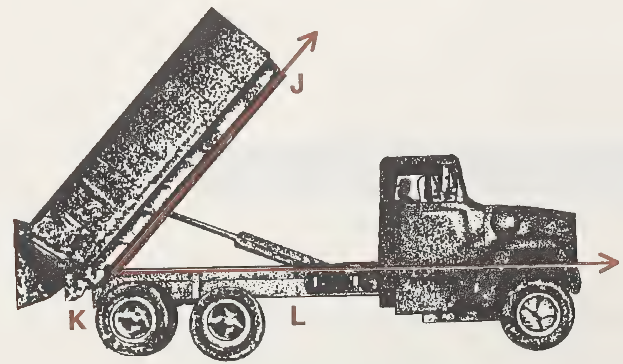
In this section you will learn these words.

- angle
- vertex (of the angle)
- rays (of the angle)
- protractor
- centre of the protractor
- baseline of the protractor
- outer scale
- inner scale
- degree lines

Working Together

In this section you will be measuring angles. First you should review how to name an angle.

Look at the following illustration.



K is called the **vertex** of the angle.

JK and KL are called the **arms** of the angle.

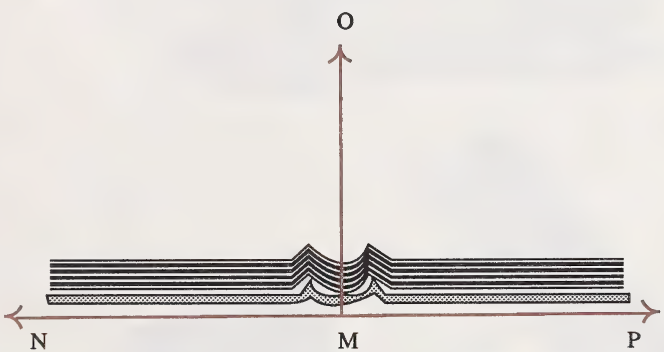
The angle in the illustration can be named three ways: $\angle JKL$, $\angle LKJ$, $\angle K$.

Notice that in the first two names the vertex (K) is in the middle of the names.

When naming angles there are sometimes two angles which share a common arm.

Example

An open book with one page lifted.



There are two angles which share the arm MO.

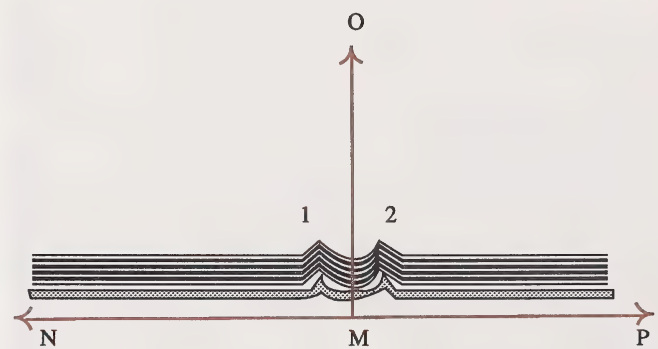
$\angle$NMO (or $\angle$OMN)

$\angle$OMP (or $\angle$PMO)

When naming these angles you cannot refer to them as $\angle$M because there would be confusion as to which angle you are naming. Is it $\angle$NMO, $\angle$OMP, or $\angle$NMP?

Sometimes these angles are numbered and referred to as $\angle 1$ and $\angle 2$.

Example



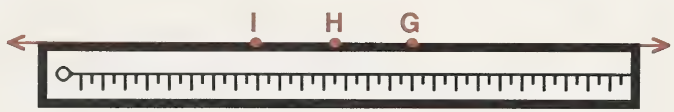
In the Introductory Activities you will review naming angles.

Introductory Activities

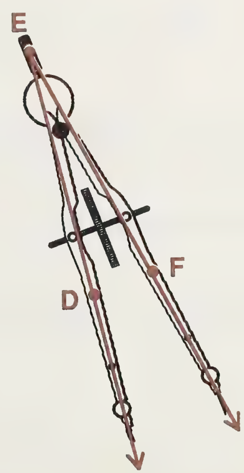
Space for Your Work

1. Name the following angles three ways.

a.

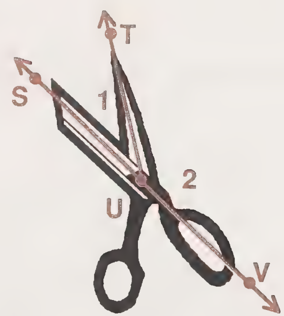


b.



Space for Your Work

2. a. Name $\angle 1$ using letters.



b. Name $\angle 2$ using letters.

See your learning facilitator to check your answers and to receive further instructions.

Working Together

Tools for Measuring Angles

A protractor is used to measure angles.

A protractor is marked off into 180 degree lines.

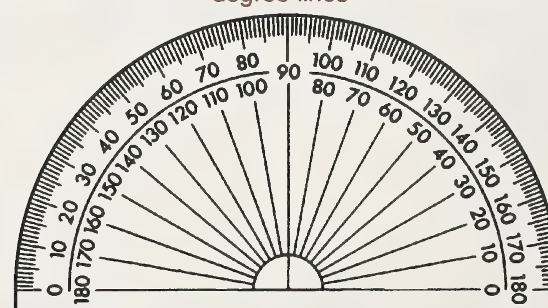
The **centre** of the protractor is the starting point for all degree lines.

The 0° line and the 180° line is called the **base line**.

The centre and the base one are used to position the protractor properly when measuring angles.

The protractor has an **outer scale** and an **inner scale**.

You should be careful to read the appropriate scale.



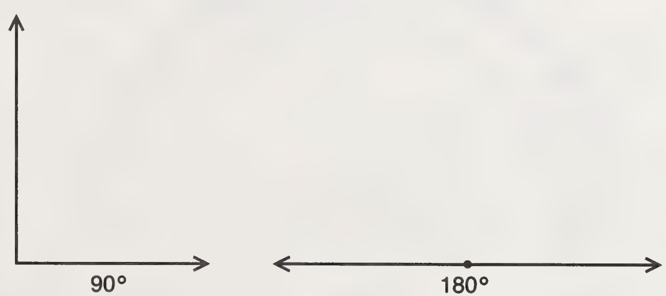
Video Activity

Watch *SOLVE IT: Measuring Angles*.

If you cannot view the video, read the notes in this section.

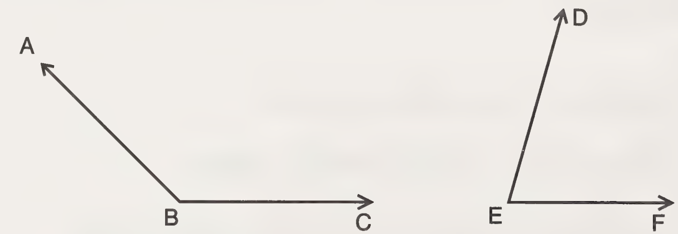
Estimating Angles

In order to estimate the measurement of angles it is important to recognize 90° and 180° angles.



Example 1

Estimate the angles.



Solution

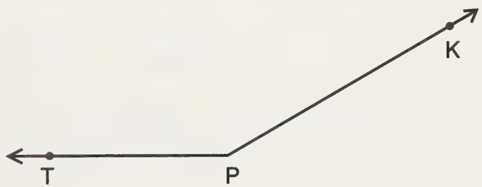
$\angle$ABC is between 90° and 180°. It is about 135°.

$\angle$DEF is less than a right angle. It is about 75°.

Using a Protractor

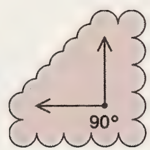
Example 2

What is the measurement of $\angle KPT$?

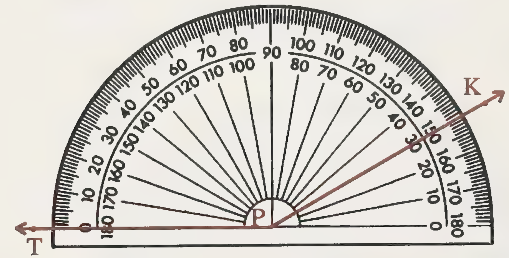


Solution

First decide whether the angle is greater than or less than 90°.



Place your protractor on the angle. Be sure the base lien of the protractor is on one arm of the angle. Be sure the centre of the protractor is at the vertex of the angle.



Decide whether to read the inner or outer scale.

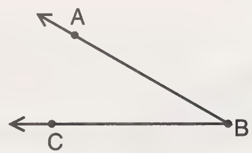
Is the correct measurement 150° or 30°?

$\angle KPT = 150°$

Practice Activities

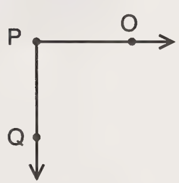
Space for Your Work

1. Estimate the measure of the following angles.

a.


b.


c.


d.


2. Measure the angles in Question 1.

See your learning facilitator to check your answers and to receive further instructions.

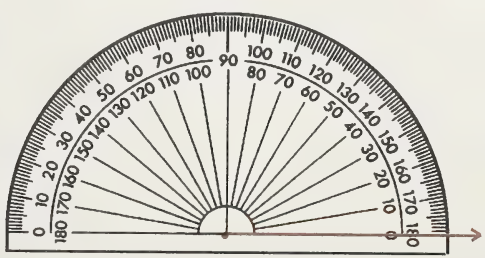
Working Together

A protractor can be used to draw angles.

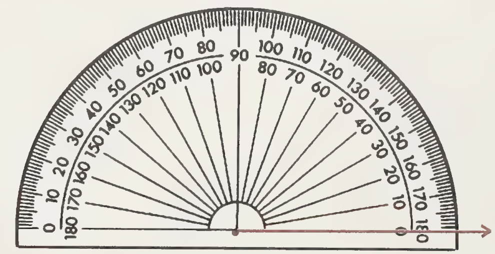
Example: Draw an angle of 45°.

Step 1: Draw a ray with a straightedge. (A ray has only one end point.)

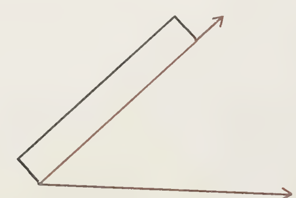
Step 2: Place the centre of the protractor on the endpoint of the ray. Line up the base line with the ray.



Step 3: Mark a dot at 45°. Be sure you use the correct scale. (45° is less than 90°.)



Step 4: Remove the protractor. With a straightedge draw a ray from the end point of the first ray through the dots.



Concluding Activities

Space for Your Work

1. Sketch these angles. Use a straightedge but do not use a protractor.

   a. 90°

   b. 180°

   c. 45°

   d. 135°

Space for Your Work

e. 20°

f. 165°

g. 75°

h. 150°

2. Measure the angles you sketched in Question 1.

Space for Your Work

3. Draw the following angles with a protractor Then compare your sketches in Question 1 and these drawings using a protractor.

   a. 90°

   b. 180°

   c. 45°

   d. 135°

Space for Your Work

e. 20°

f. 165°

g. 75°

h. 150°

Computer Activity

4. Do "Learning all the Angles" on Disk B of MAC 6.

5. Play "Geo Pool and Geo Billiards." It is a fun game using angles.

Space for Your Work

See your learning facilitator to check your answers and to receive further instructions.

EQUIVALENT MEASURES

What Lies Ahead

In this section you will learn to change from one linear unit to another.

Working Together

In this section you will learn to change from one unit to another. This is, you will write equivalent forms of the same measure.

It is easy to change from one unit to another in the metric system because the units are multiples of ten.

1 km = 10 hm
1 hm = 10 dam
1 dam = 10 m
1 m = 10 dm
1 dm = 10 cm
1 cm = 10 mm

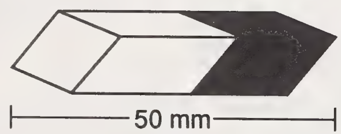
You can use a metric ladder to help you remember metric units of length.

larger units ← | km | hm | dam | m | dm | cm | mm | → smaller units

The same relationship exists with the mass units and the capacity units.

Example 1

This eraser is 50 mm long. How many centimetres long is it?



Solution

Two methods can be used.

Method 1

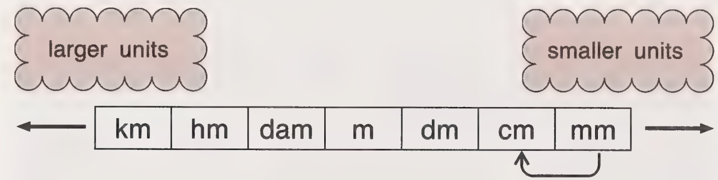
Since 10 mm = 1 cm, divide by 10.

$$50 \div 10 = 5$$

The eraser is 5 cm long.

Method 2

Use the metric ladder. Move the decimal point one place for each step on the metric ladder.



Move the decimal point 1 place to the left.

$$50. = 5$$

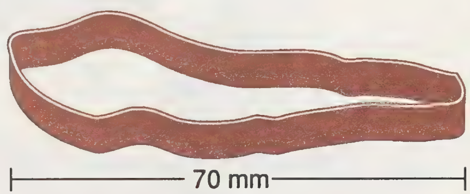
The eraser is 5 cm long.

Note

When you change to a larger unit, there will be fewer units.

Example 2

This elastic band is 7 cm long. How many millimetres long is it?



Solution

Method 1

Since 1 cm = 10 mm, multiply by 10.

$$7 \div 10 = 70$$

The elastic band is 70 mm long.

Method 2

Use the metric ladder.

larger units ← → smaller units

km	hm	dam	m	dm	cm	mm

Move the decimal point 1 place to the right.

$$7.0 = 70$$

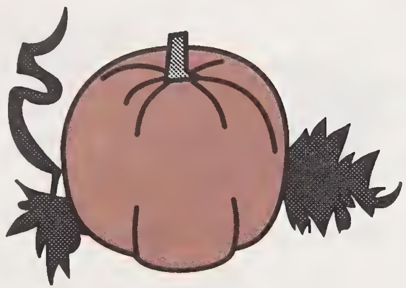
The elastic band is 70 mm long.

Note

When you change to a smaller unit there will be more units.

Example 3

What is the mass in kilograms?



Method 1

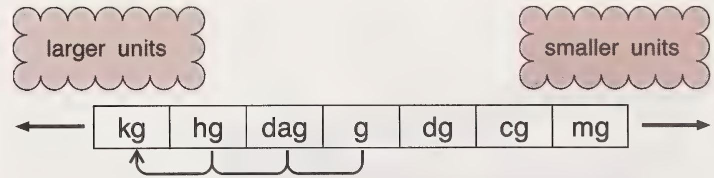
Since 1000 g = 1 kg, divide by 1000.

$$1257 \div 1000 = 1.257$$

The pumpkin has a mass of 1.257 kg.

Method 2

Use the metric ladder.



Move the decimal point 3 places to the left.

$$1257.0 = 1.257$$

The pumpkin has a mass of 1.257 kg.

Example 4

What is the mass in grams?

Method 1

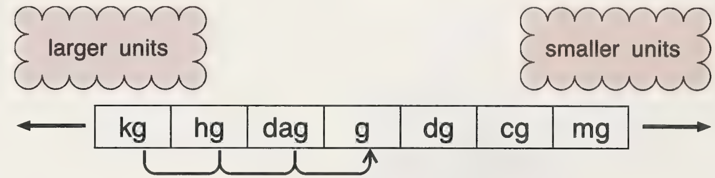
Since 1 kg = 1000 g, multiply by 1000.

$$3.5 \times 1000 = 3500$$

The cat has a mass of 3500 g.

Method 2

Use the metric ladder.



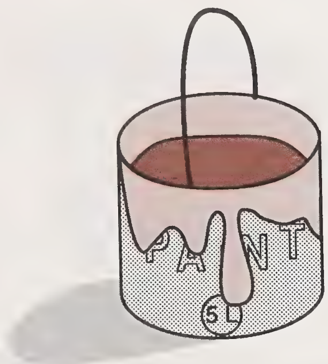
Move the decimal point 3 places to right.

$$3.500 = 3500$$

The cat has a mass of 3500 g.

Example 5

What is the capacity in mL?



Method 1

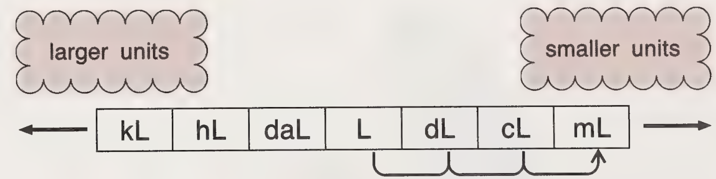
Since 1 L = 1000 mL, multiply by 1000.

$$5 \times 1000 = 5000$$

The paint can holds 5000 mL

Method 2

Use the metric ladder.



Move the decimal point 3 places to right.

$$5.000 = 5000$$

The paint can holds 5000 mL.

Example 6

What is the capacity in litres?

Method 1

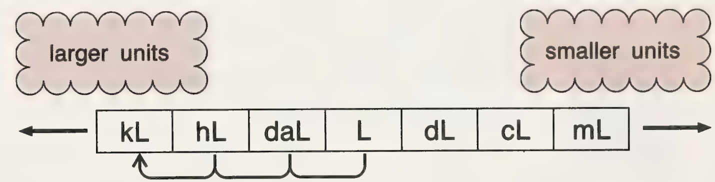
Since 1000 mL = 1 L, divide by 1000.

$$750 \div 1000 = 0.75$$

The shampoo bottle holds 0.75 L.

Method 2

Use the metric ladder.



Move the decimal point 3 places to left.

$$750 = 0.750$$
$$= 0.75$$

The shampoo bottle holds 0.75 L.

Practice Activities

Space for Your Work

Computer Alternative

1. Do Lessons 3-9 from the Measurement disk of the package *Computer Drill and Instruction: Mathematics*, Level D.

Print Alternative

2. Complete.

   a. 24 cm = ________ mm

   b. 129 m = ________ m

   c. 4 L = ________ mL

   d. 412 g = ________ kg

   e. 316 m = ________ cm

   f. 4.8 kg = ________ g

   g. 95 mL = ________ L

   h. 75 g = ________ mg

Space for Your Work

3. Complete the charts.

a.

m	cm	mm
5.25		
	121.7	
		4392

b.

kg	g	mg
7.9		
	80	
		702

c.

kL	L	mL
2.542		
	3	
		85

See your learning facilitator to check your answers and to receive further instructions.

SUMMARY

What Lies Ahead

In this section you will review these skills.

- estimating and measuring the length, mass, capacity, perimeter, area, and volume of an object
- comparing the areas of objects with the same perimeter
- relating volume and capacity in the metric system
- estimating and measuring angles
- changing from one unit to another

Working Together

At this point, it would be a good idea to review the skills you have learned in Part One.

Turn to Section 1 and review the Pretest. Then correct any errors you may have made. You may be pleasantly surprised to discover how much you have learned!

PART TWO

In Part Two you will be learning about motion geometry, congruent figures, similar figures, and symmetry.

You will also create geometrical patterns.

GETTING SET

What Lies Ahead

In this section you will test your knowledge of these concepts.

- slides, flips, turns
- congruent figures
- similar figures
- flip and turn symmetry
- tiling
- tesselations
- geometric designs

Working Together

This section is designed to pretest the skills you will be learning in Sections 15 to 25. It will help you and your learning facilitator discover your strengths and weaknesses.

Pretest

Space for Your Work

1. What transformation (slides, turns, or flips) are suggested by the following?

   a. moving furniture into a new house

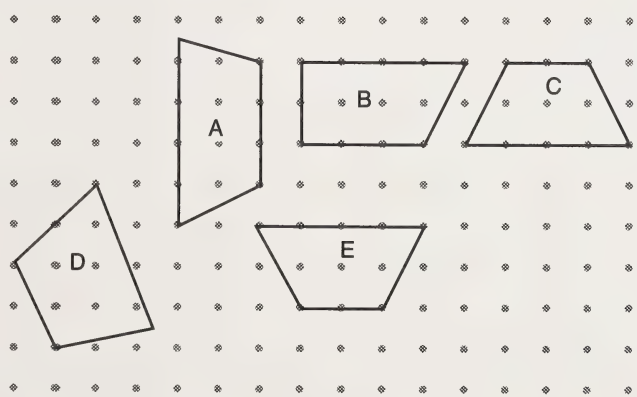
   b. playing both sides of a record

   c. resetting your watch

   d. raising a flag up a flag pole

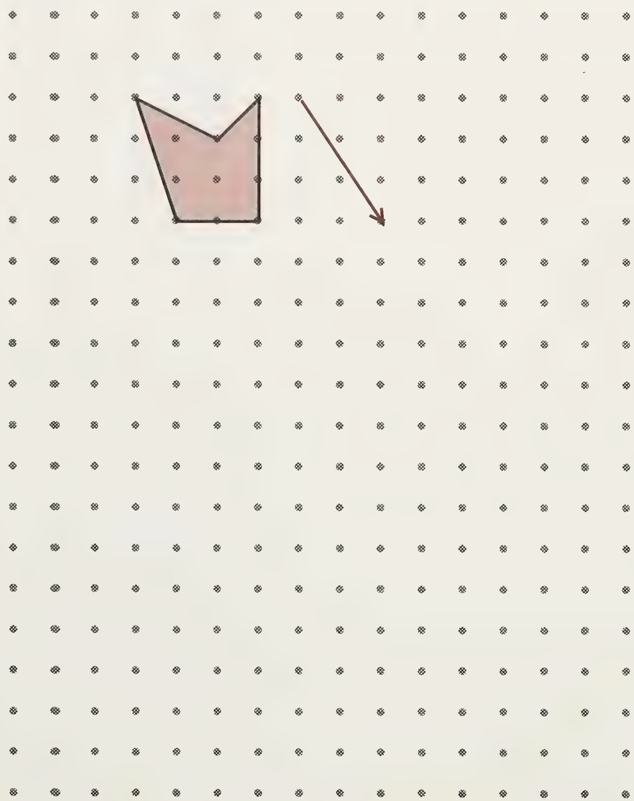
   e. playing chess or checkers

2. Circle the congruent figures.



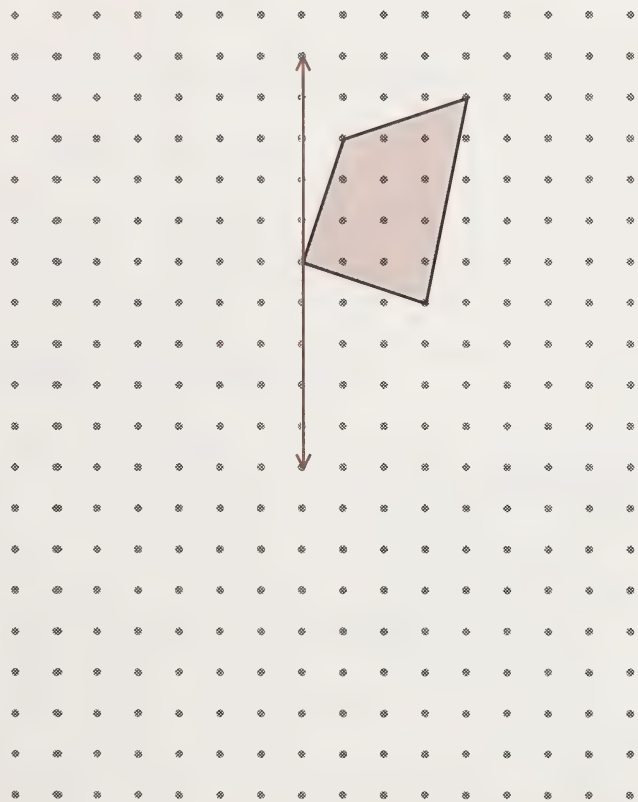
Space for Your Work

3. Draw the slide image for the given slide arrow. (You may use the tracing paper provided at the end of the booklet.)



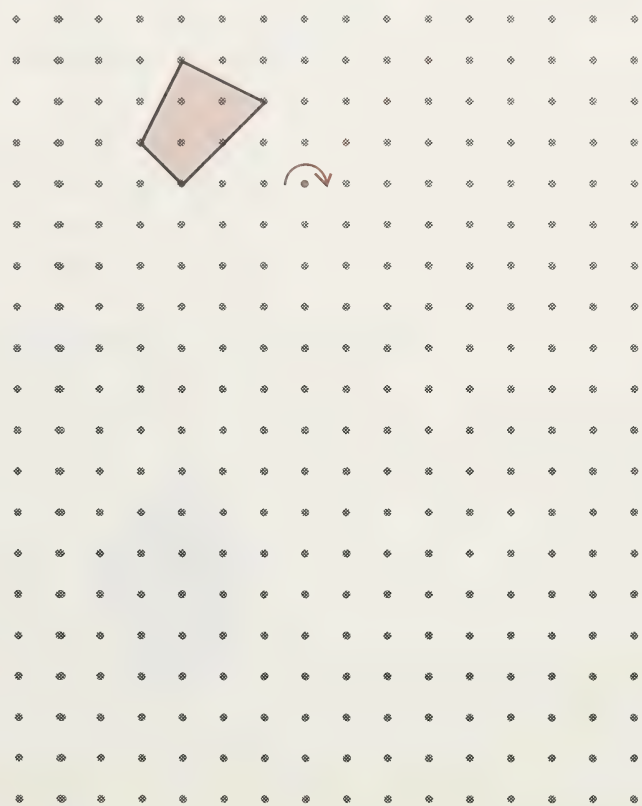
Space for Your Work

4. Draw the flip image for the given flip line. (You may use the tracing paper provided at the end of the booklet.)

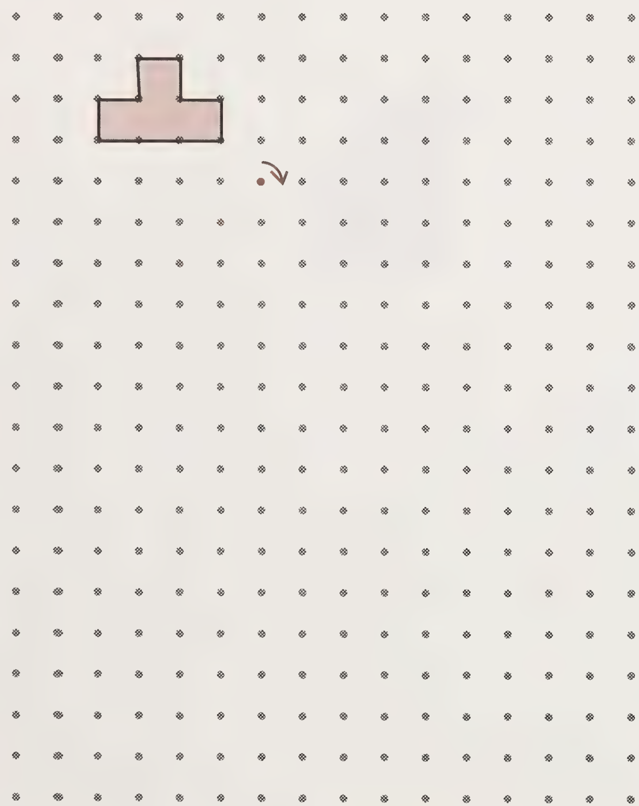


Space for Your Work

5. Draw the $\frac{1}{2}$-turn image for the given turn centre. (You may use the tracing paper provided at the end of the booklet.)



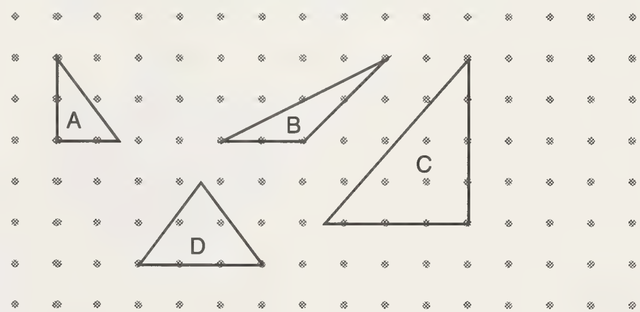
6. Draw the $\frac{1}{4}$-turn image for the given turn angle. (You may use the tracing paper provided at the end of the booklet.)



Space for Your Work

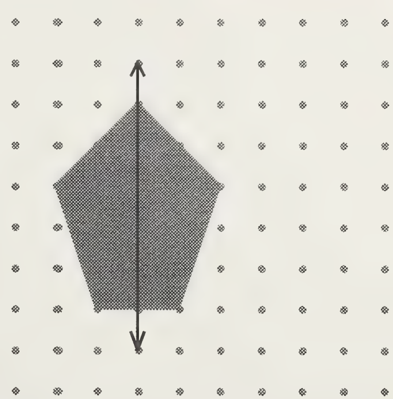
Space for Your Work

7. Circle the similar figures.

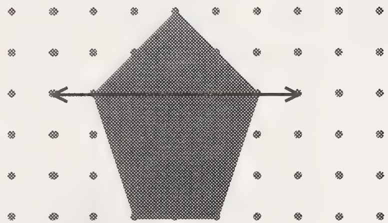


8. Is this line a line of symmetry?

a.

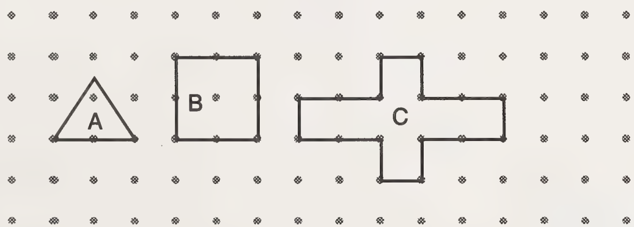


b.

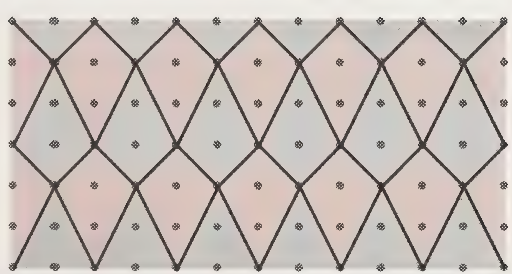


Space for Your Work

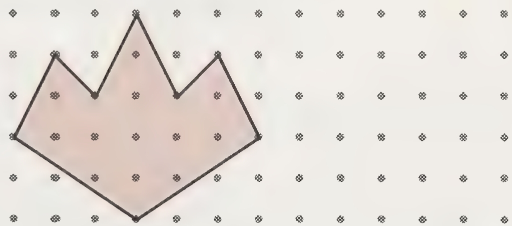
9. Which figure has a turn order of two?



10. How many different shapes are used to make this tiling pattern?



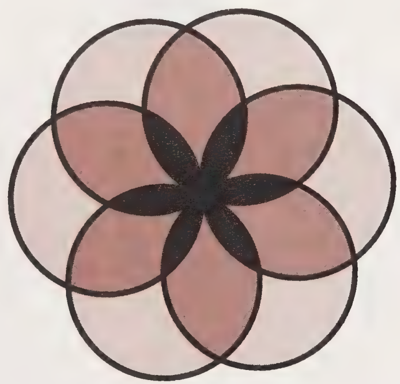
11. Create a tesselation with this shape.



Space for Your Work

11.

12. Construct this design with a compass. (You can make the design larger.)



Space for Your Work

See your learning facilitator to check your answers and to receive further instructions.

SLIDES

What Lies Ahead

In this section you will learn to draw the slide image of an object.

In this section you will learn these words.

- slide
- slide arrow
- slide image
- translation
- image

Working Together

This section deals with slides. A **slide** in geometry occurs when an object moves from its original position to a new position in a straight line.

These pictures suggest slides.

Note

The formal name for a slide is a **translation**.

Slides can be shown on paper.

Note

- The original position of the object is represented by the coloured figure.
- The new position of the figure (the slide image) is represented by the uncoloured figure.
- The slide arrow indicates that the object moves to the right.

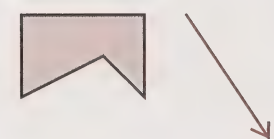
Drawing Slide Images with Tracing Paper

The following example shows how to draw the slide image for a given slide arrow using tracing paper.

Remember the slide image is the new position of the figure.

Example

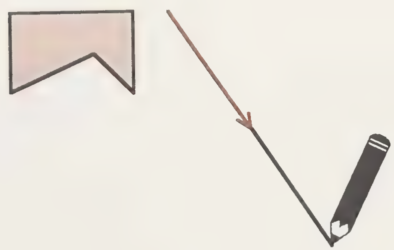
Use tracing paper to draw the slide image of the figure for the given slide arrow.



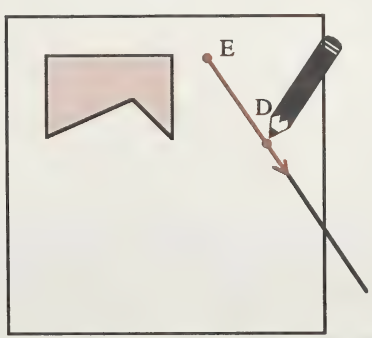
The solution is on the next page.

Solution

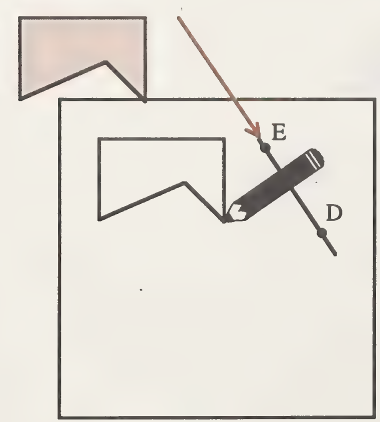
Step 1: Extend the arrow.



Step 2: Cover the figure and arrow with tracing paper. Trace the figure on the tracing paper and mark two points (E the endpoint of the arrow and D another point on the arrow) on the tracing paper.



Step 3: Slide the tracing so that E and D move along the slide arrow. Stop when E is over the tip of the arrow. Mark the vertices of the figure on the tracing paper by pressing heavily with a pencil.



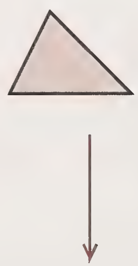
Step 4: Remove the tracing. Draw the slide image by joining the vertices.

Introductory Activities

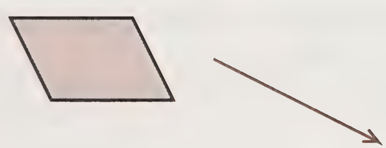
Space for Your Work

Draw the slide image of the figures for the given slide arrow. Use the tracing paper provided at the end of this booklet.

1.



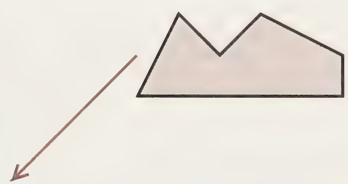
2.



Space for Your Work

3.

4.



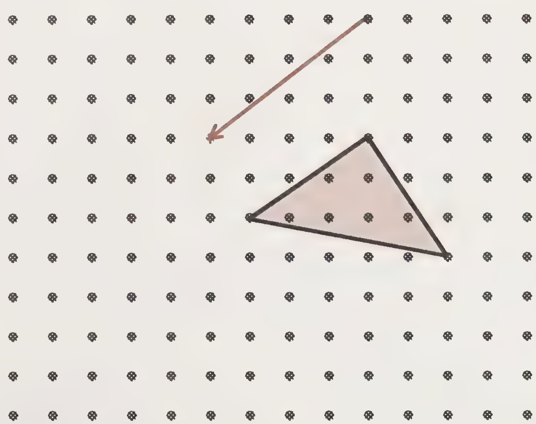
See your learning facilitator to check your answers and to receive further instructions.

Drawing Slide Images with Dot Paper

Slide images can be drawn using dot paper or grid paper.

Example

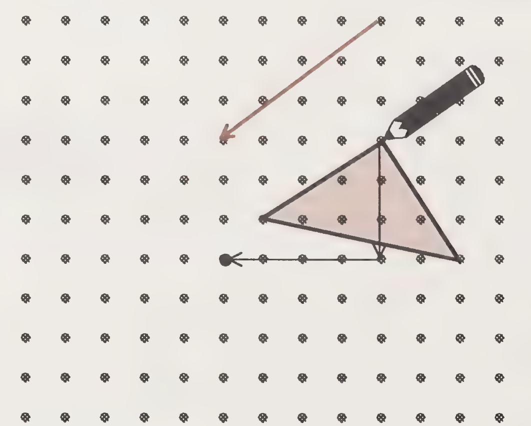
Draw the slide image for the given slide arrow.



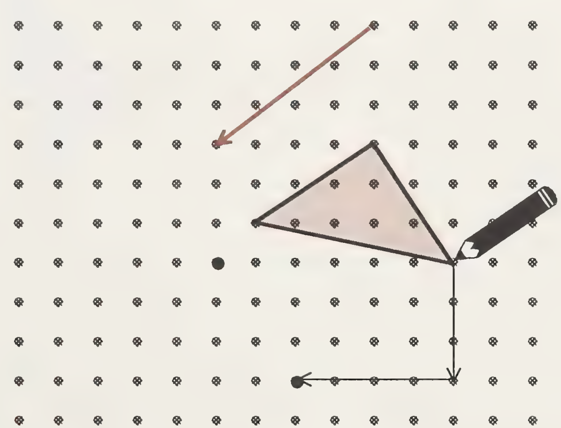
Solution

Step 1: Determine the amount and direction of the slide. To get to the tip of the arrow from the end of the arrow, you go down 3 and left 4.

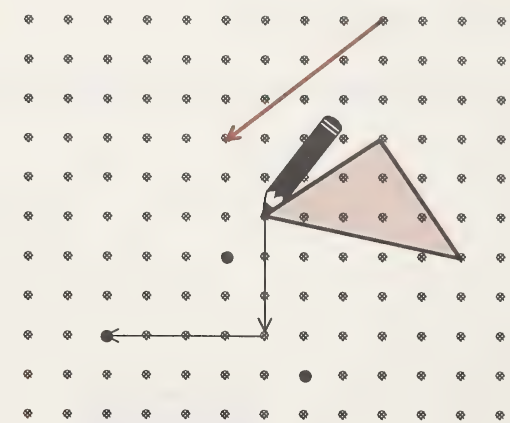
Step 2: Put your pencil tip on one vertex, count down 3, and to the left 4. Put a dot.



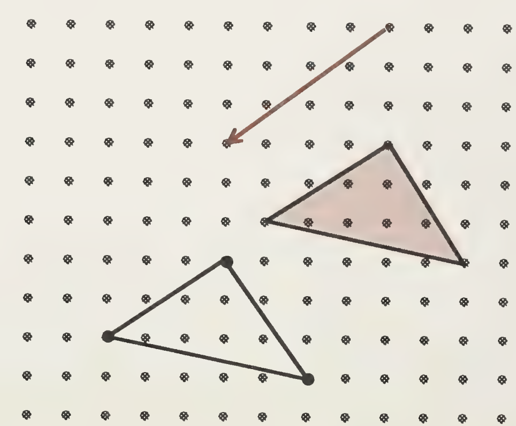
Step 3: Put your pencil on another vertex. Count down 3 and to the left 4. Put a dot.



Step 4: Put your pencil on the third vertex. Count down 3 and to the left 4. Put a dot.



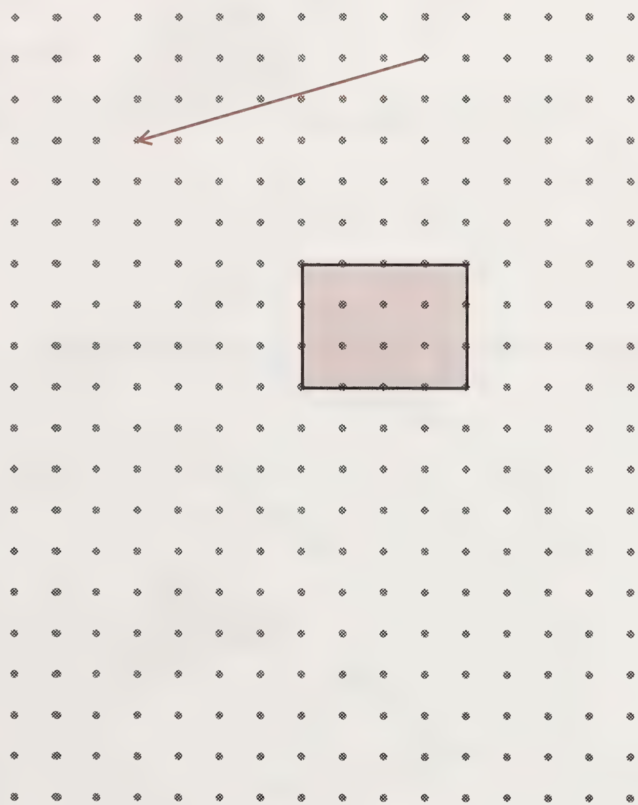
Step 5: Join the dots to show the slide image.



Practice Activities

Draw the slide images for the given slide arrows.

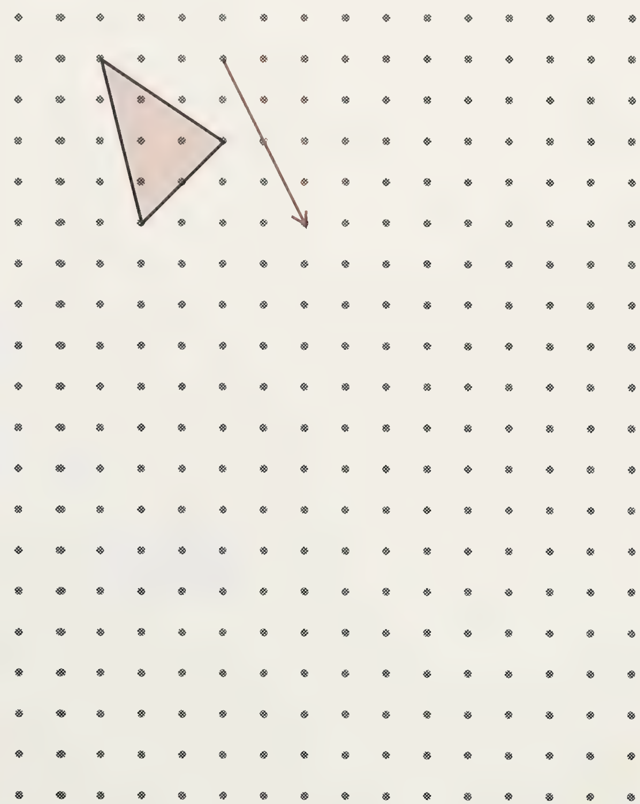
1.



Space for Your Work

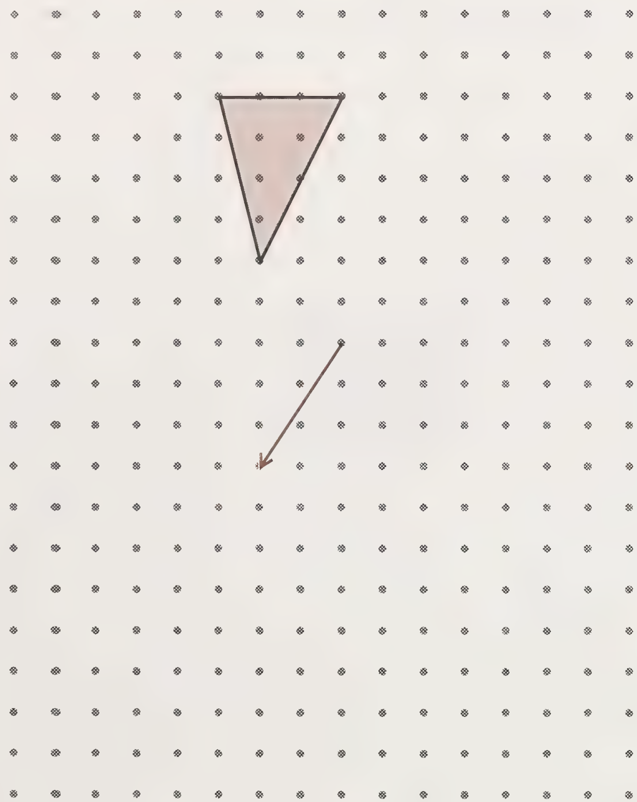
Space for Your Work

2.



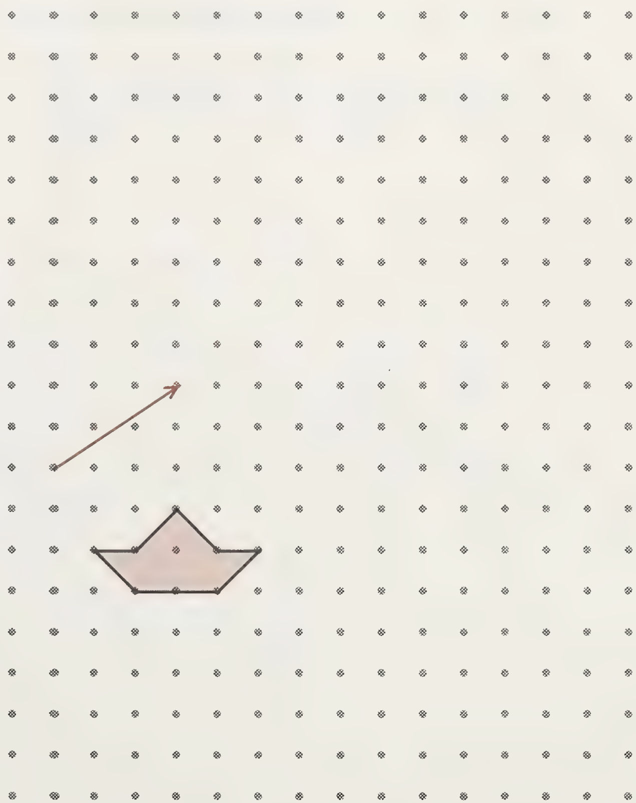
Space for Your Work

3.

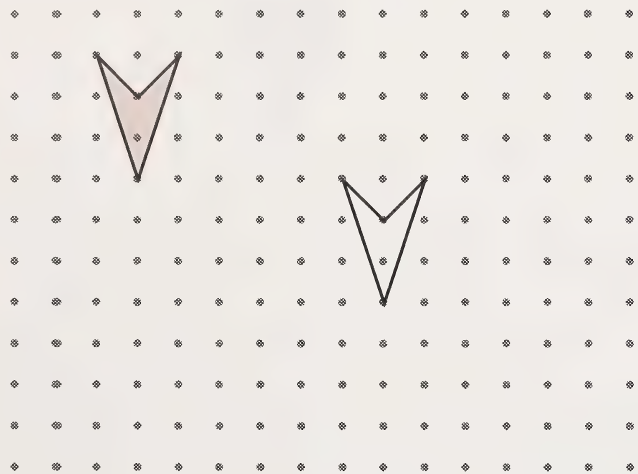


Space for Your Work

4.



5. Draw the slide arrow for the following figure and slide image.



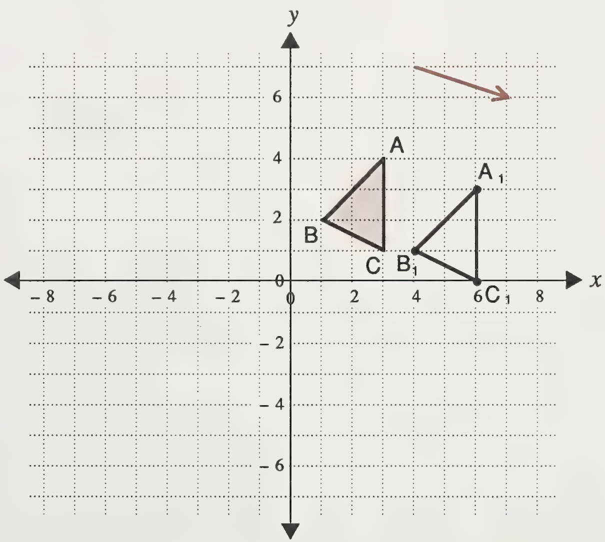
Space for Your Work

See your learning facilitator to check your answers and to receive further instructions.

Concluding Activities

1. Slide images can be drawn on graph paper.

   a. Write the coordinates of the vertices of the triangle and its slide image in the table at the right.



   b. The slide arrow shows the figure has been moved right 3 and down 1. What pattern do you see in the coordinates of the corresponding vertices? (That is, A and A_1, B and B_1, C and C_1)

Space for Your Work

1. a.

Triangle

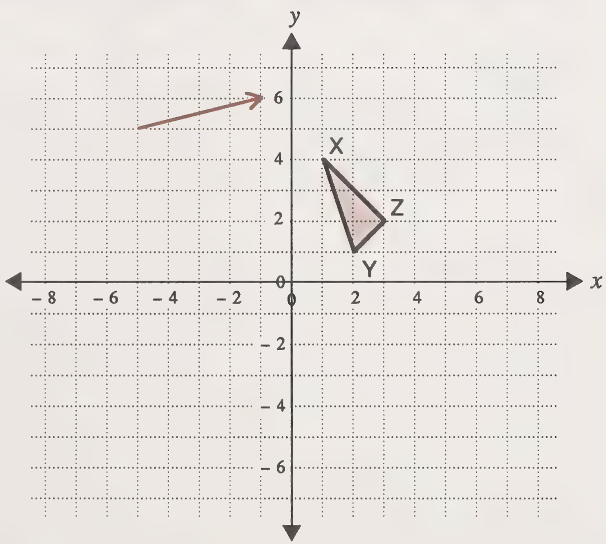
vertex	coordinates
A	
B	
C	

Image

vertex	image
A_1	
B_1	
C_1	

Space for Your Work

2. Draw the slide image after a slide of right 4 and up 1.



See your learning facilitator to check your answers and to receive further instructions.

FLIPS

What Lies Ahead

In this section you will learn to draw the flip image of an object.

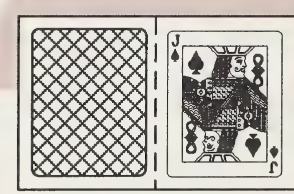
In this section you will learn these words.

- flip
- flip image
- flip line
- reflection
- MIRA

Working Together

This section deals with flips. A **flip** in geometry is a motion that occurs when an object is flipped over a line called a flip line.

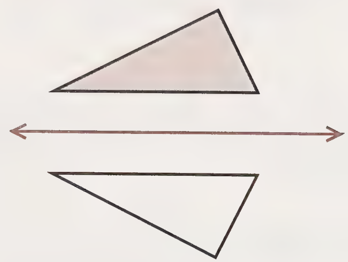
These pictures suggest flips.



When you flip an object, the object does not change in any way. Only the location changes.

Note: The formal name for a flip is a **reflection**.

Flips can be shown on paper.



Note

- The original position of the object is represented by the shaded figure.
- The new position of the figure (the flip image) is represented by the unshaded figure.
- The flip line indicates the line over which the object is flipped.

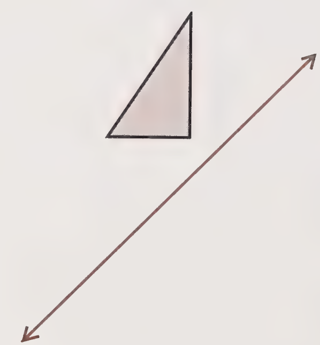
Drawing Flip Images with Tracing Paper

The following example shows the flip image for a given flip line using tracing paper.

Remember the flip image is the new position of the figure.

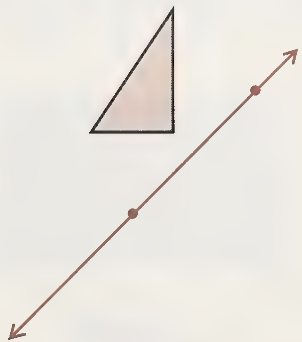
Example

Draw the flip image for the given flip line. Use tracing paper.

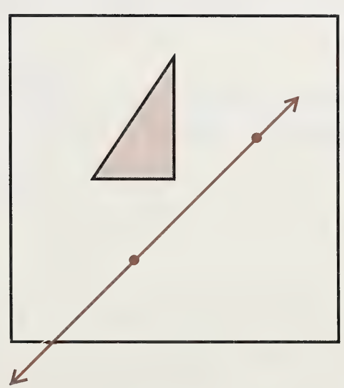


Solution

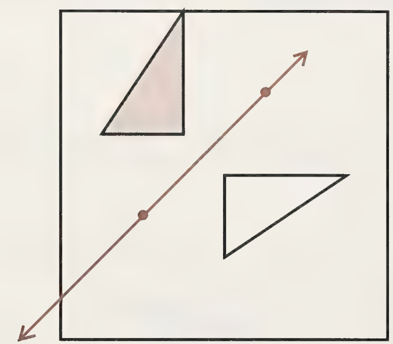
Step 1: Make 2 dots on the flip line.



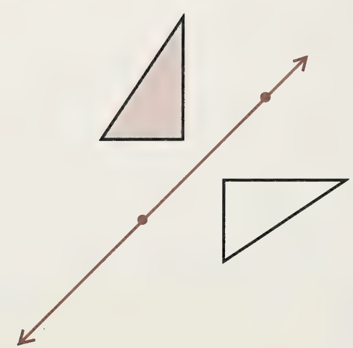
Step 2: Trace the figure and the 2 dots using tracing paper.



Step 3: Flip the tracing. Match the two dots. Mark the vertices of the tracing by pressing heavily with a pencil.



Step 4: Remove the tracing. Draw the flip image by joining the vertices. Use a straightedge.

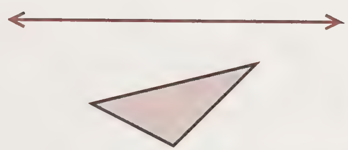


Drawing Flip Images with a MIRA

A plexiglass mirror called a MIRA can also be used to draw the flip images for a given flip line.

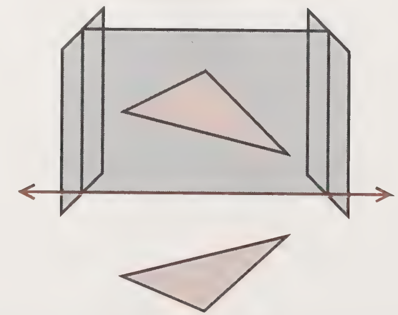
Example

Draw the flip image for the given flip line. Use a MIRA.



Solution

Step 1: Place the MIRA straight up on the flip line. If you look through the MIRA you will see a reflected image of the original figure.



Step 2: Reach behind the MIRA with a pencil and mark the positions of the vertices of the image.

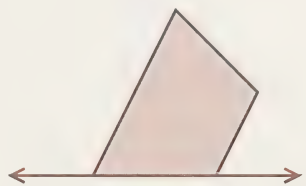
Step 3: Remove the MIRA, and draw the flip image by joining the points.

Introductory Activities

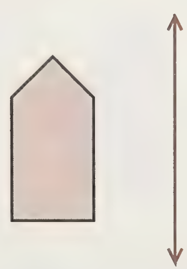
Space for Your Work

Draw the flip image for the given flip line. Use tracing tracing paper provided at the end of this booklet.

1.

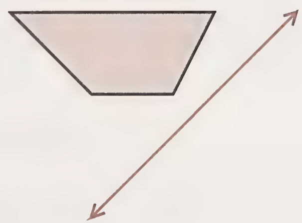


2.

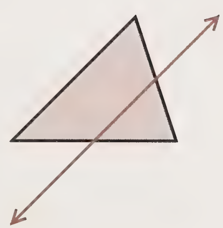


Space for Your Work

3.



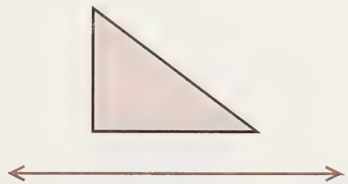
4.



Space for Your Work

5. Draw the flip images for the given flip line. Use a MIRA.

a.



b.

See your learning facilitator to check your answers and to receive further instructions.

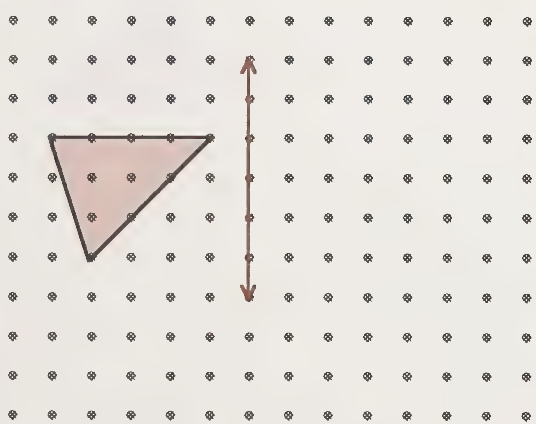
Working Together

Drawing Slide Images with Dot Paper

Dot paper or grid paper also can be used to draw the flip image for a given flip line.

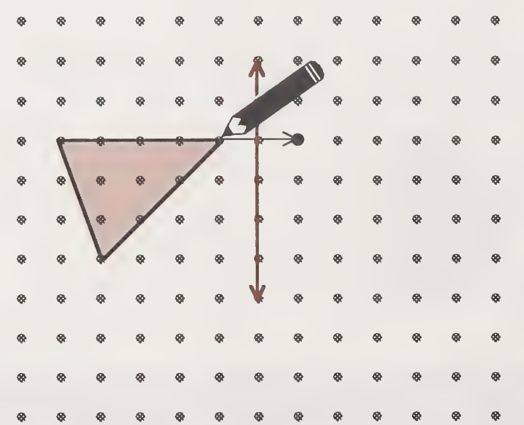
Example

Draw the flip image for the given flip line.

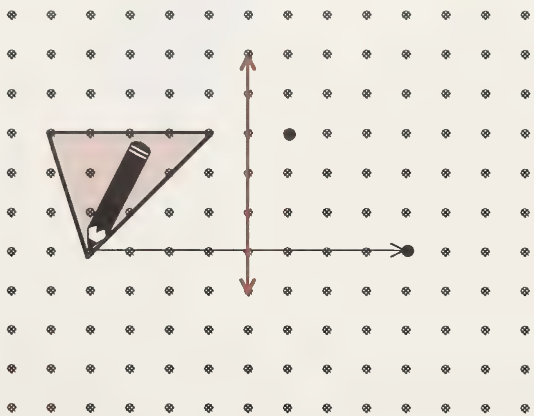


Solution

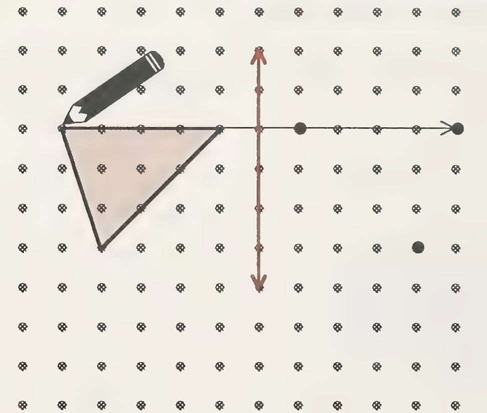
Step 1: Put your pencil on a vertex. Count the number of units the vertex is from the flip line. Count the same number of units on the other side of the flip line and make a dot.



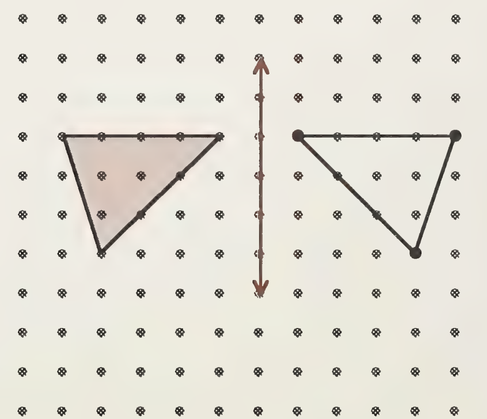
Step 2: Put your pencil on a second vertex. Put a dot an equal distance on the other side of the flip line.



Step 3: Put your pencil on the last vertex. Put a dot an equal distance on the other side of the flip line.



Step 4: Connect the dots.

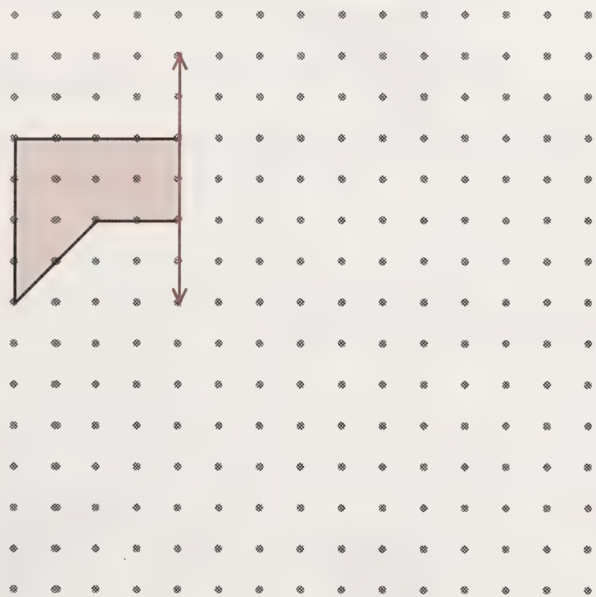


Practice Activities

Space for Your Work

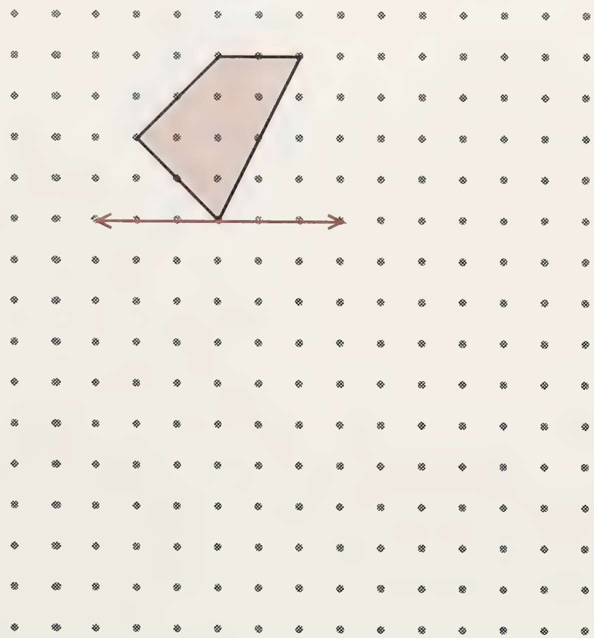
1. Draw the flip images for the given flip lines.

   a.



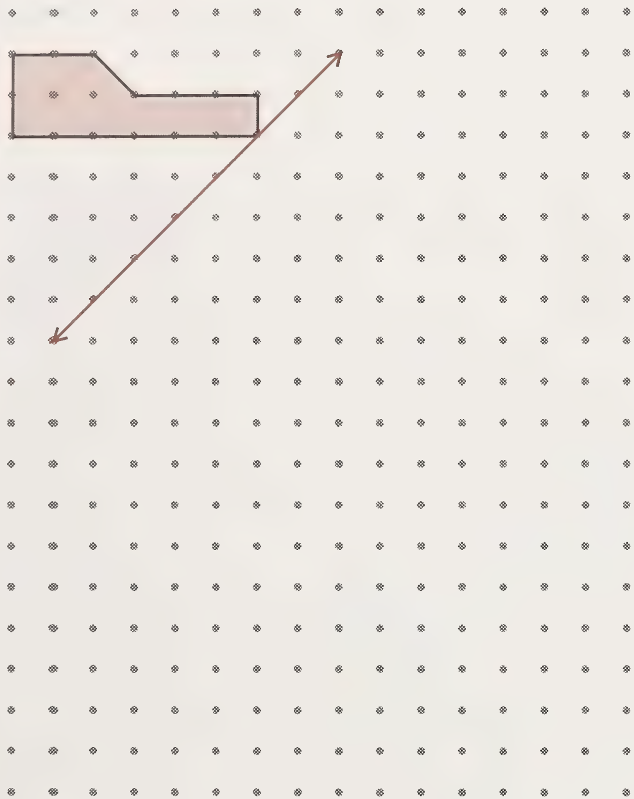
Space for Your Work

b.



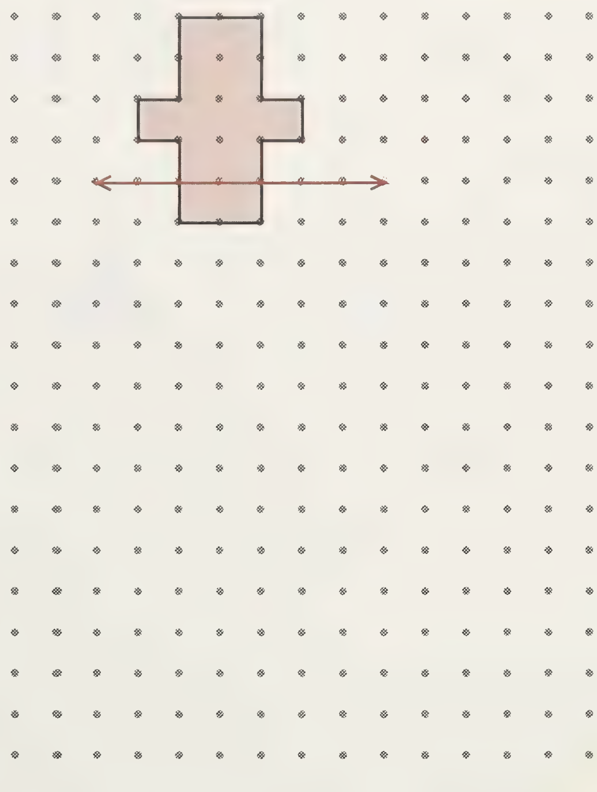
Space for Your Work

c.



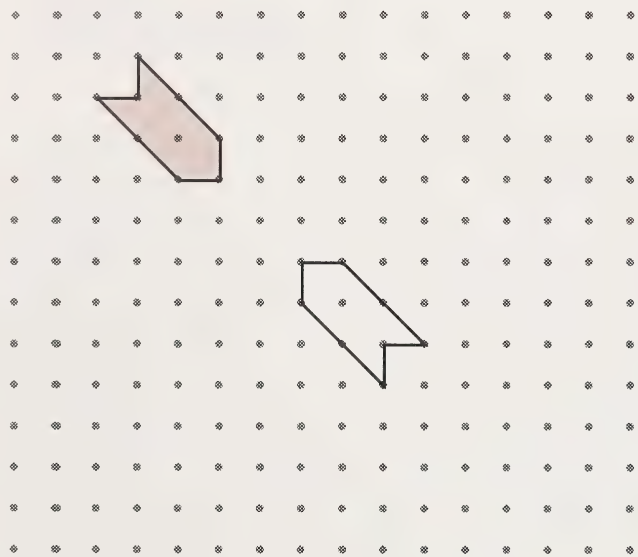
Space for Your Work

d.



Space for Your Work

2. Show the flip line.



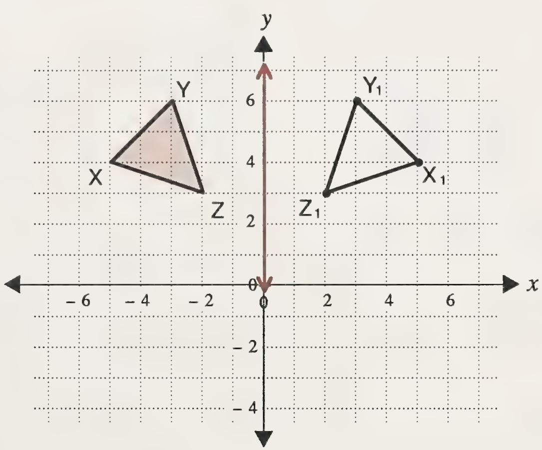
See your learning facilitator to check your answers and to receive further instructions.

Concluding Activities

Space for Your Work

1. Flips can also be shown on graph paper.

   a.



   b. The flip line is on the vertical axis. What pattern do you notice in the coordinates of the corresponding vertices (X and X_1, Y and Y_1, Z and Z_1)?

1. a.

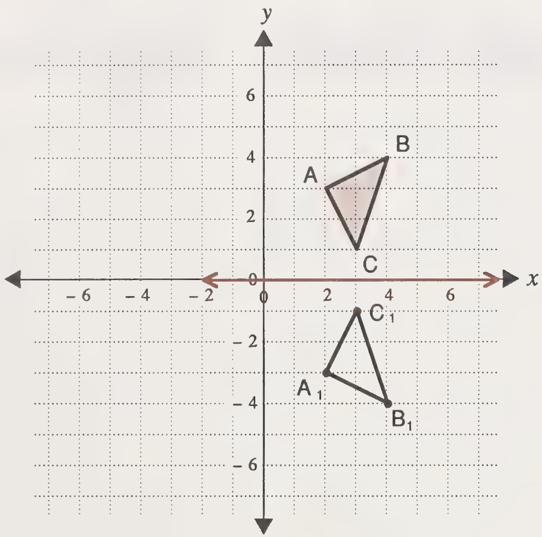
Triangle

vertex	coordinates
X	
Y	
Z	

Image

vertex	coordinates
X_1	
Y_1	
Z_1	

2. a. Write the ordered pairs for the triangle and its flip image in the table at the right.



b. The flip line is on the horizontal axis. What pattern do you notice in the coordinates of the corresponding vertices?

Space for Your Work

2. a.

Triangle

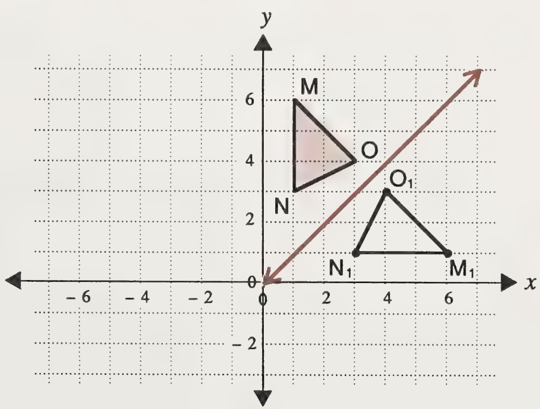
vertex	coordinates
A	
B	
C	

Image

vertex	coordinates
A_1	
B_1	
C_1	

Space for Your Work

3\. a. Write the ordered pairs for the triangle and its flip image in the table at the right.



b. The flip line is at a 45° angle with the horizontal axis and vertical axis. What pattern do you notice with the coordinates of the corresponding angles?

3\. a.

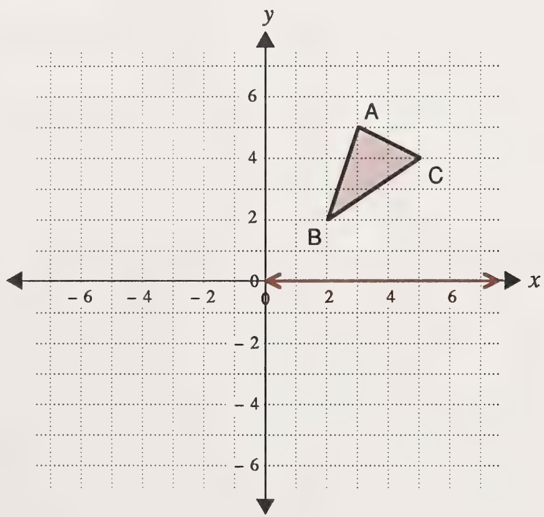
Triangle

vertex	coordinates
M	
N	
O	

Image

vertex	coordinates
M_1	
N_1	
O_1	

4. Draw the flip image of this triangle. The flip line is on the horizontal axis.



Space for Your Work

See your learning facilitator to check your answers and to receive further instructions.

TURNS

What Lies Ahead

In this section you will learn to draw the turn image of an object.

In this section you will learn these words.

- turn
- turn angle
- turn centre
- rotation
- clockwise
- counterclockwise

Working Together

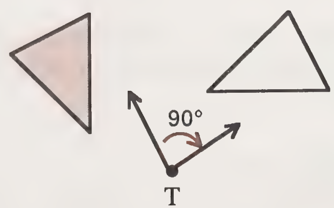
This section deals with turns. A **turn** in geometry is a motion that occurs when an object is turned around a fixed point.

These pictures suggest turns.

When you turn an object, the object does not change in any way. Only the location changes.

Note: The formal name for a turn is a **rotation**.

Turns can be shown on paper.

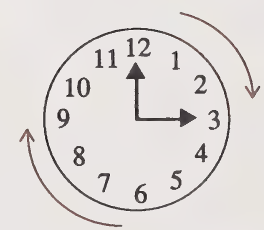


Note

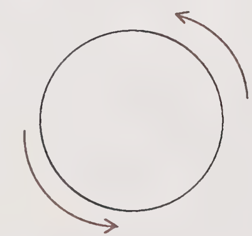
- The original position of the object is represented by the shaded figure.
- The new position of the figure (the turn image) is represented by the unshaded figure.
- The turn angle indicates the fixed point around which the object turns, the direction of the turn and the amount of the turn.

Turn angles can be described as clockwise (cw) or counterclockwise (ccw).

Remember the hands on a clock move in a clockwise direction. The opposite direction is called counterclockwise.



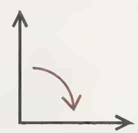
clockwise



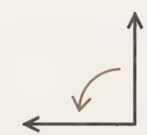
counterclockwise

Turns can also be described using degrees or as a fraction of a turn.

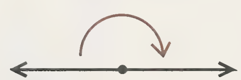
Examples



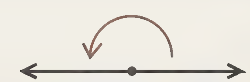
90° cw or $\frac{1}{4}$ turn cw



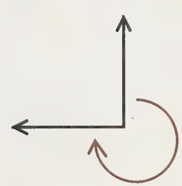
90° ccw or $\frac{1}{4}$ turn ccw



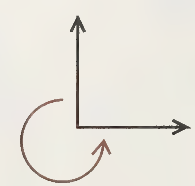
180° cw or $\frac{1}{2}$ turn cw



180° ccw or $\frac{1}{2}$ turn ccw



270° cw or $\frac{3}{4}$ turn cw



270° ccw or $\frac{3}{4}$ turn ccw

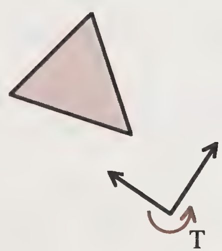
Drawing Turn Images with Tracing Paper

The following example shows how to draw the turn image for a given turn angle using tracing paper.

Remember the turn image is the new position of the figure.

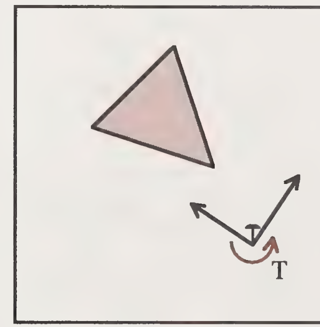
Example

Draw the turn image given this turn angle. Use tracing paper.

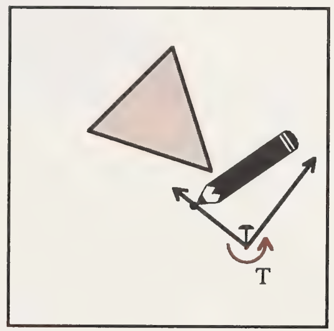


Solution

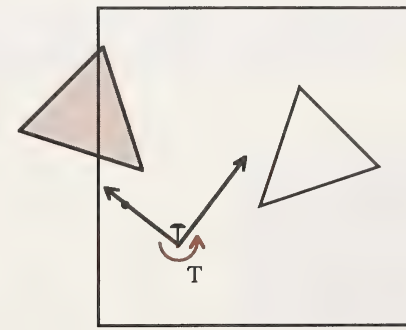
Step 1: Cover the figure and the turn angle with tracing paper. Push a pin through the tracing paper into the turn centre.



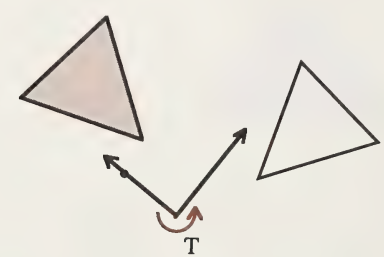
Step 2: Trace the figure. Mark a dot on the beginning area of the turn angle.



Step 3: Turn the tracing paper counterclockwise around the turn centre until the dot on the tracing falls on the other arm of the turn angle. Mark the vertices of the figure on the tracing paper by pressing hard with a pencil.



Step 4: Remove the tracing paper and draw the turn image by connecting the vertices.

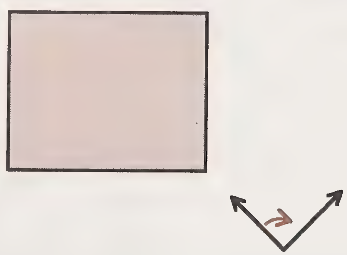


Introductory Activities

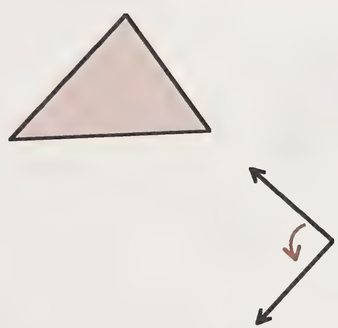
Space for Your Work

Draw the turn images of the figures for the given turn angles. Use the tracing paper provided.

1.

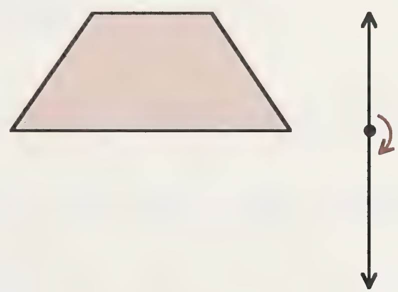


2.



Space for Your Work

3.



Space for Your Work

4.

See your learning facilitator to check your answers and to receive further instructions.

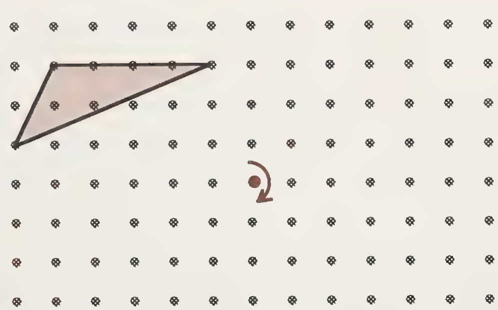
Working Together

Drawing $\frac{1}{2}$-Turn Images Using Dot Paper

$\frac{1}{2}$-turn images can be drawn using dot or grid paper.

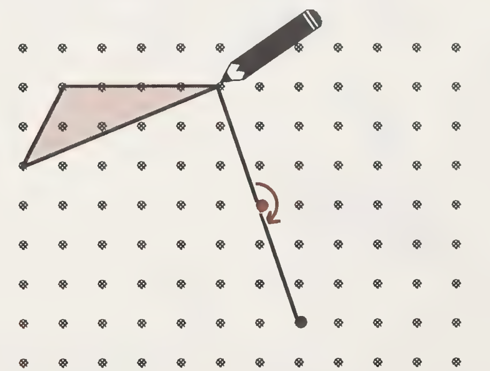
Example

Draw the $\frac{1}{2}$-turn image for the given turn centre.

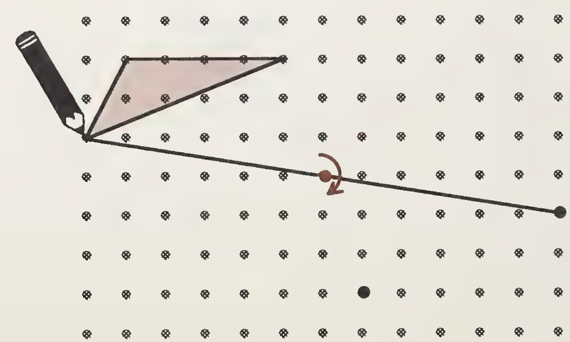


Solution

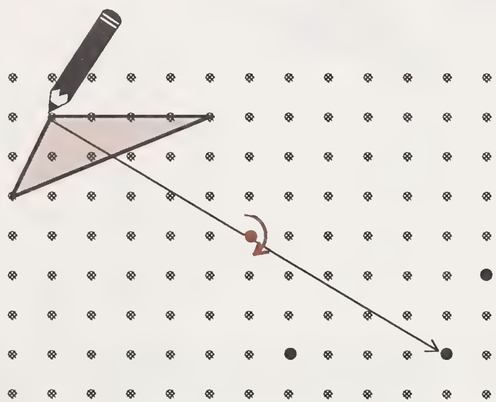
Step 1: Put a pencil at one vertex and count the spaces to the turn centre (right 1, down 3). Put a dot on the other side of the turn centre (right 1, down 3).



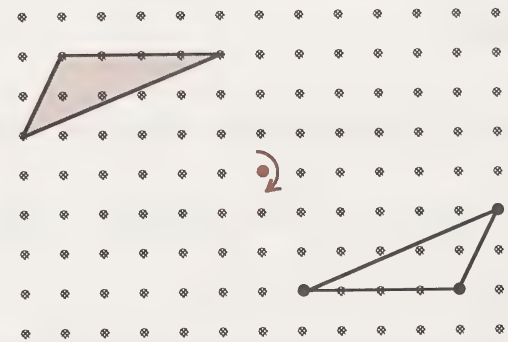
Step 2: Put the pencil on another vertex and count the spaces to the turn centre (right 6, down 1). Put a dot on the other side of the turn centre (right 6, down 1).



Step 3: Put the pencil on the final vertex and count the spaces to the turn centre (right 5, down 3). Put a dot on the other side of the turn centre (right 5, down 3).



Step 4: Join the dots.

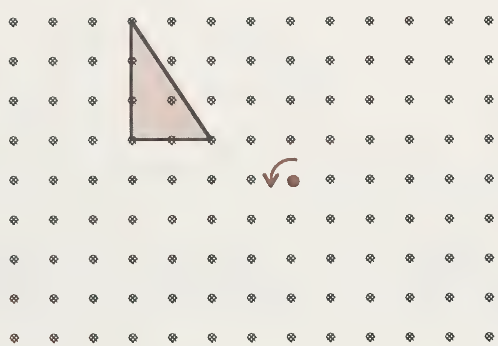


Drawing $\frac{1}{4}$-Turn Images

You can draw $\frac{1}{4}$-turn images using dot paper.

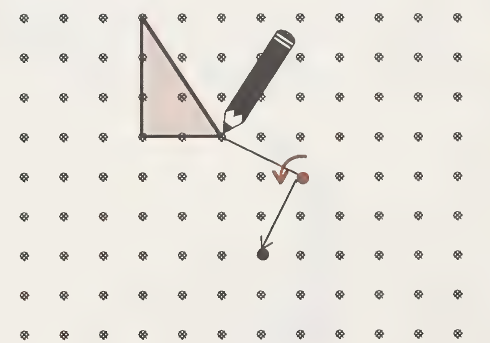
Example

Draw the $\frac{1}{4}$-turn image for the given turn centre.

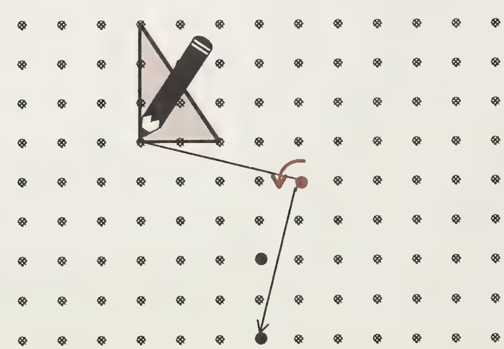


Solution

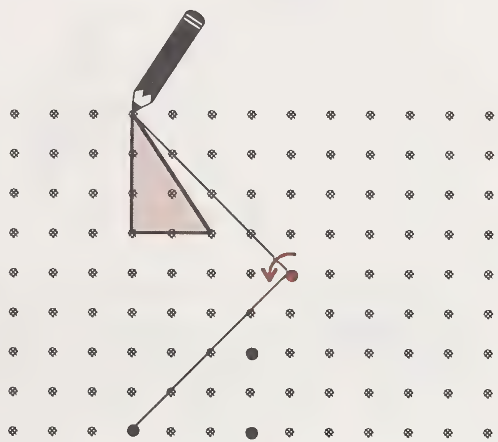
Step 1: Put a pencil on one vertex and count the spaces to the turn centre (right 2, down 1). Put a dot on the other side of the turn centre (down 2, left 1).



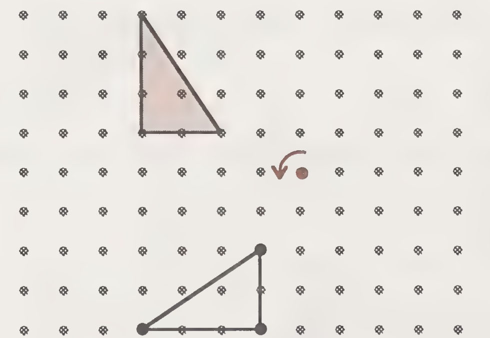
Step 2: Put the pencil on another vertex and count the spaces to the turn centre (right 4, down 1). Put a dot on the other side of the turn centre (down 4, left 1).



Step 3: Put the pencil on the last vertex and count the spaces to the turn centre (right 4, down 4). Put a dot on the other side of the turn centre (right 4, down 4).



Step 4: Join the dots.



Here are a few more hints to help you draw turn images with dot paper.

- The matching points of the figure and the turn image must be the same distance from the turn centre.

- Start an image by using a point which is close to the turn centre because the new location of a close point will be easier to find. Then copy the rest of the figure.

- The turn image will be in the same position for a turn of 270° ccw and 90° cw, or 270° cw and 90° ccw.

Practice Activities

Space for Your Work

1. What is the direction and amount of the following turn angles? (Use a fraction.)

   a. 

   b. 

   c. 

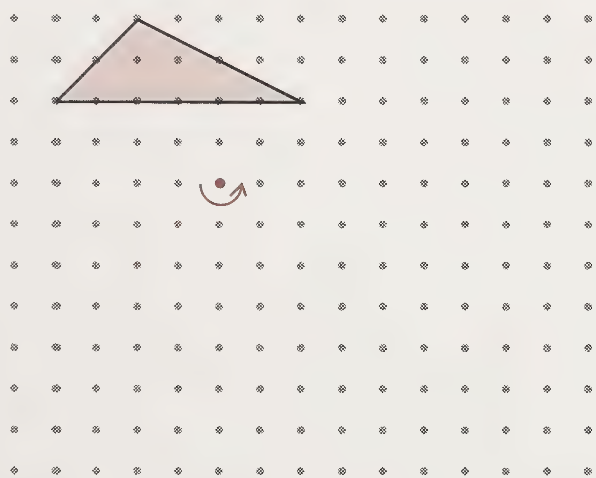
   d. 

Space for Your Work

2. Show a $\frac{3}{4}$-ccw turn at the turn centre.

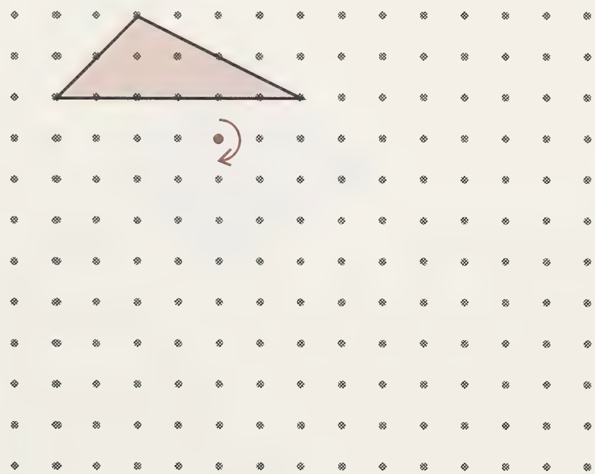
3. Draw the $\frac{1}{2}$-turn images for the given turn centres.

a.

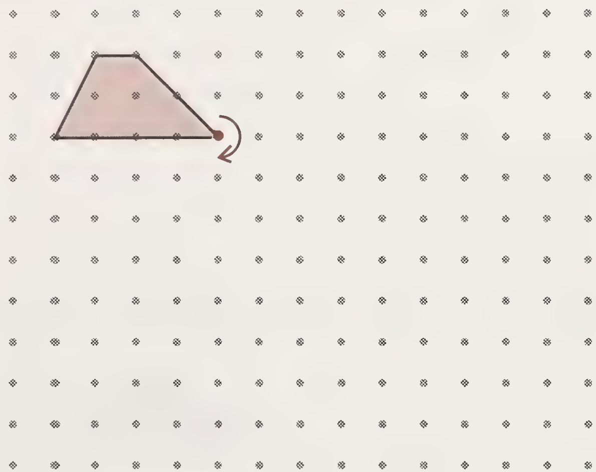


Space for Your Work

b.



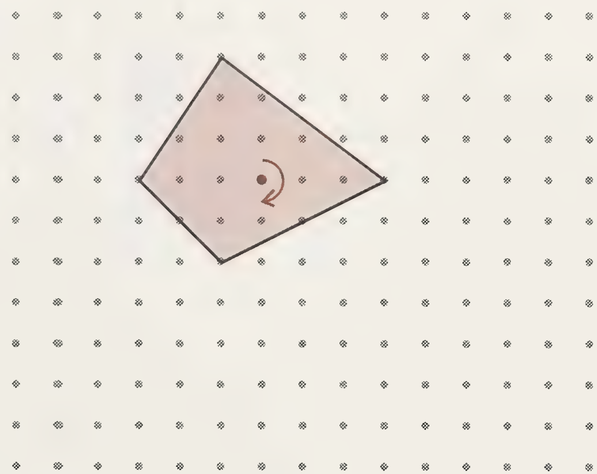
c.



Space for Your Work

Space for Your Work

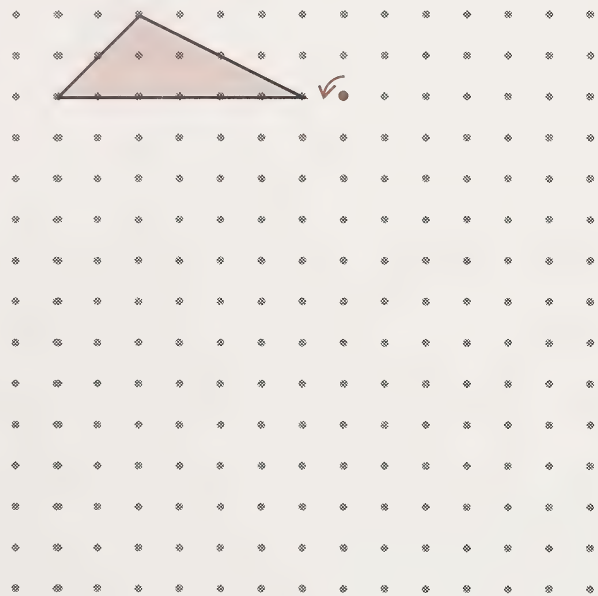
d.



Space for Your Work

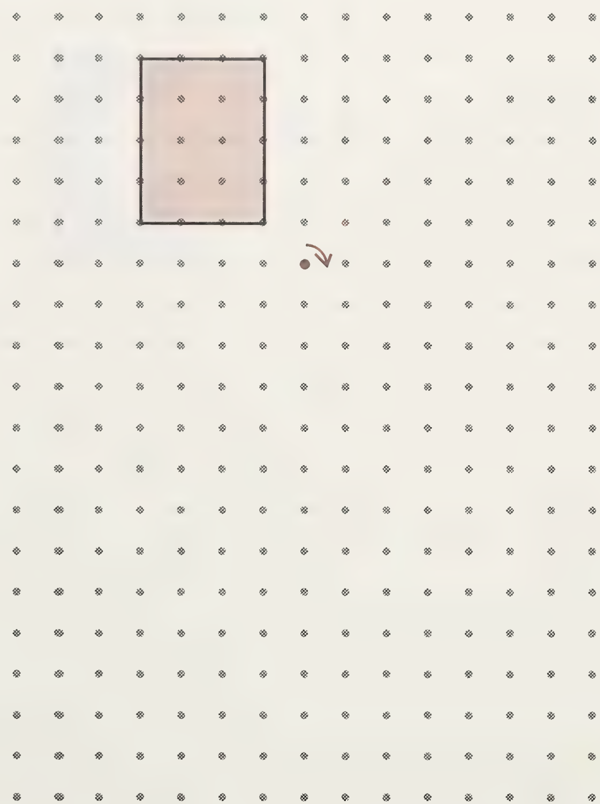
4. Draw the turn images for the given turn angles.

a.



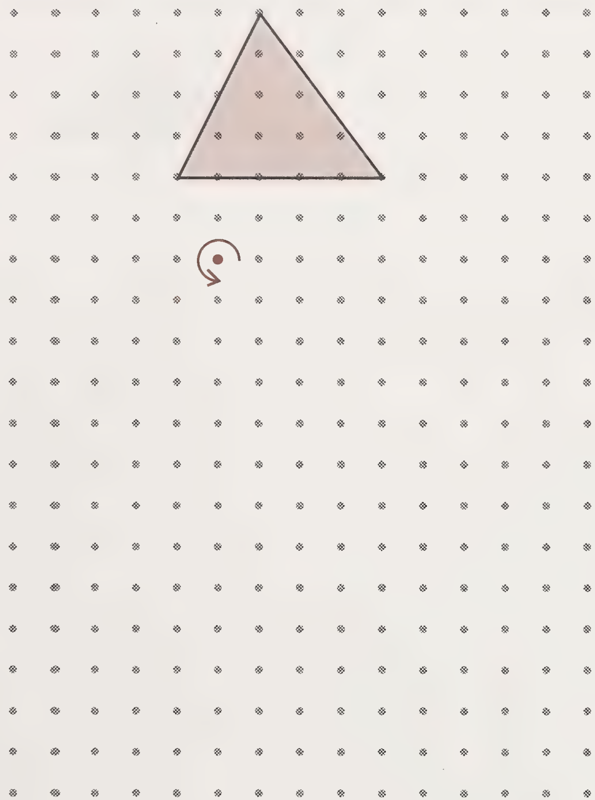
Space for Your Work

b.



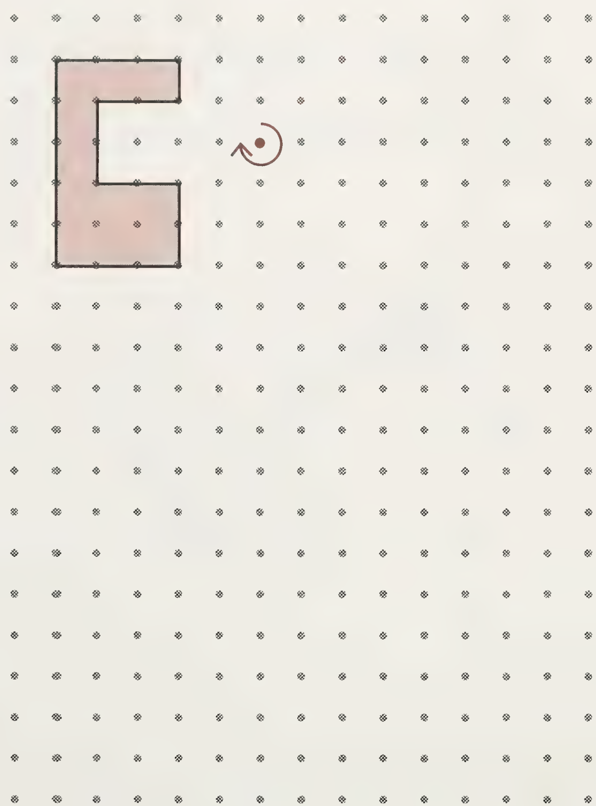
Space for Your Work

c.



Space for Your Work

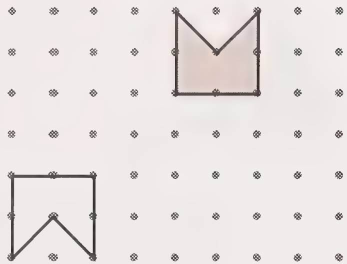
d.



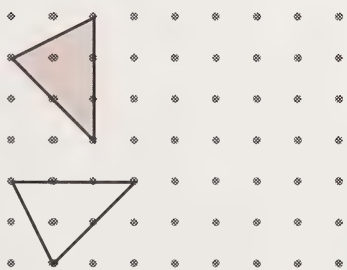
Space for Your Work

5. Give the turn angle for each of the following.

a.



b.



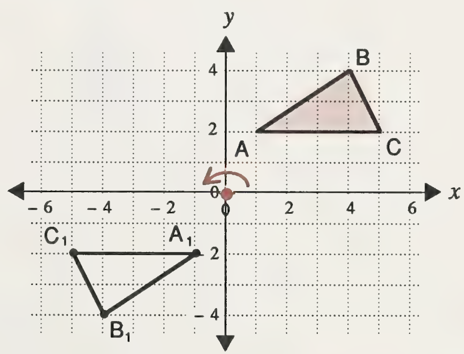
See your learning facilitator to check your answers and to receive further instructions.

Concluding Activities

Space for Your Work

1. You can show turn images on graph paper.

   a. Write the coordinates of the vertices of the triangle and its turn image in the tables at the right.



   b. The turn centre is at the origin and the turn image is $\frac{1}{2}$-turn ccw. What pattern do you notice in the coordinates of the corresponding vertices (A and A_1, B and B_1, C and C_1)?

1\. a.

Triangle

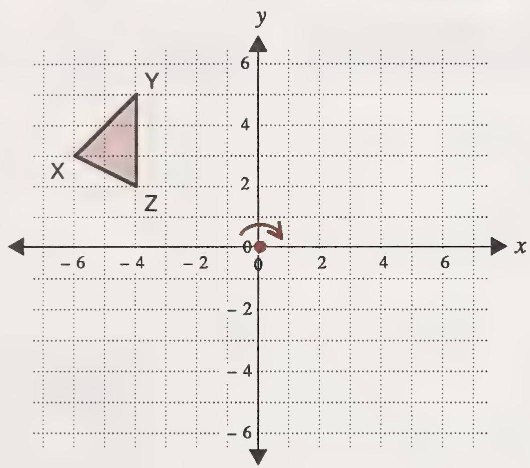
vertex	coordinates
A	
B	
C	

Image

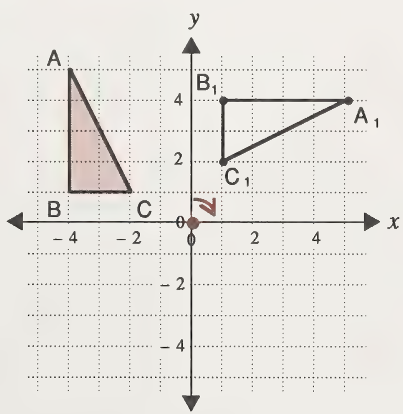
vertex	coordinates
A_1	
B_1	
C_1	

Space for Your Work

2. Draw the $\frac{1}{2}$-turn image of the triangle. The turn centre is at the origin.



3. a. Write the coordinates of the vertices of the triangle and its turn image in the tables at the right.



b. The turn centre is at the origin and the turn angle is $\frac{1}{4}$ turn cw. What pattern do you notice in the coordinates of the corresponding vertices (A and A_1, B and B_1, C and C_1)?

Space for Your Work

3. a.

Triangle

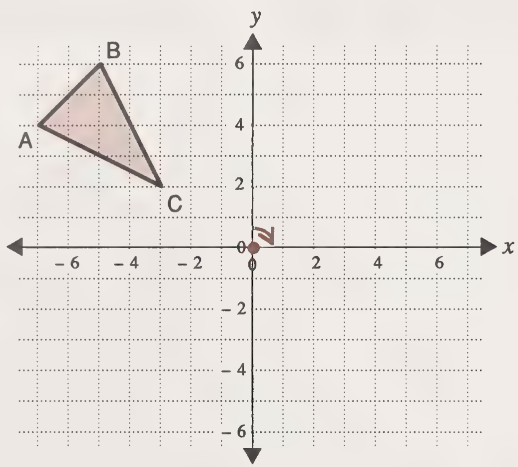
vertex	coordinates
A	
B	
C	

Image

vertex	coordinates
A_1	
B_1	
C_1	

Space for Your Work

4. Draw the $\frac{1}{4}$-turn image of the triangle. The turn centre is at the origin.



See your learning facilitator to check your answers and to receive further instructions.

CONGRUENT FIGURES

What Lies Ahead

In this section you will learn these skills.

- interpreting congruent figures
- testing to discover if 2 figures are congruent by flipping, turning, and sliding

In this section you will learn these words.

- congruent
- congruence
- corresponding angles
- corresponding sides

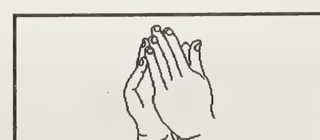
Working Together

This section you will learn about **congruence**. Objects are congruent if they have the same size and shape.

If a figure can be placed over another figure so that each one matches the other at all points, they are congruent.

You probably can tell, just by sight, that your hands are congruent.

You can check the congruence by putting your hands together to see if they match.



Introductory Activities

Space for Your Work

1. Look at the figures labelled "Section 18 Figures" in the appendix of this booklet. Name the figures which appear to be congruent.

2. Cut out the figures. Then test to see if the figures are congruent. (Put two figures together. If they match exactly, they are congruent.)

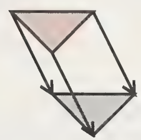
See your learning facilitator to check your answers and to receive further instructions.

Working Together

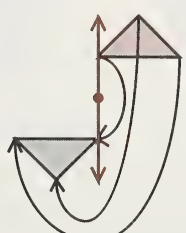
Using Tracing Paper to Test for Congruence

There are three different ways to show that figures are congruent.

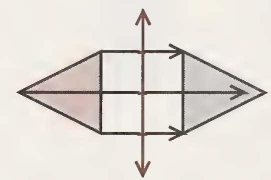
- You can slide one figure onto the other.



- You can turn one figure onto the other.



- You can flip one figure onto the other.

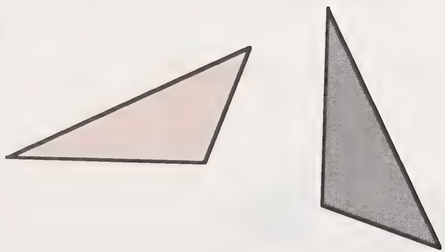


In the Introductory Activities you checked congruence by cutting out and matching figures. Now you will learn how to check congruence by sliding, turning or flipping a tracing of a figure.

See the example on the next page.

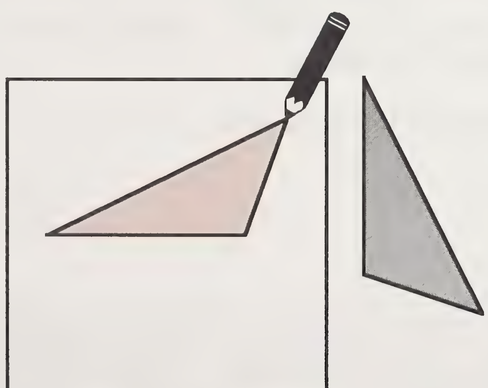
Example

Are these triangles congruent?

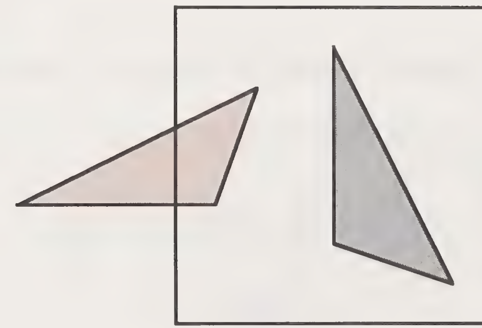


Solution

Step 1: Trace one of the figures.



Step 2: Move the tracing over the other figure. (In this case you have to slide and flip, or slide and turn, the tracing.)



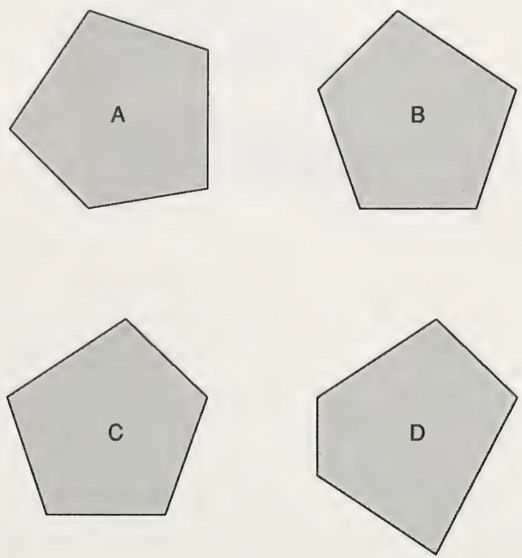
The tracing matches the second figure so the figures are congruent.

Practice Activities

Space for Your Work

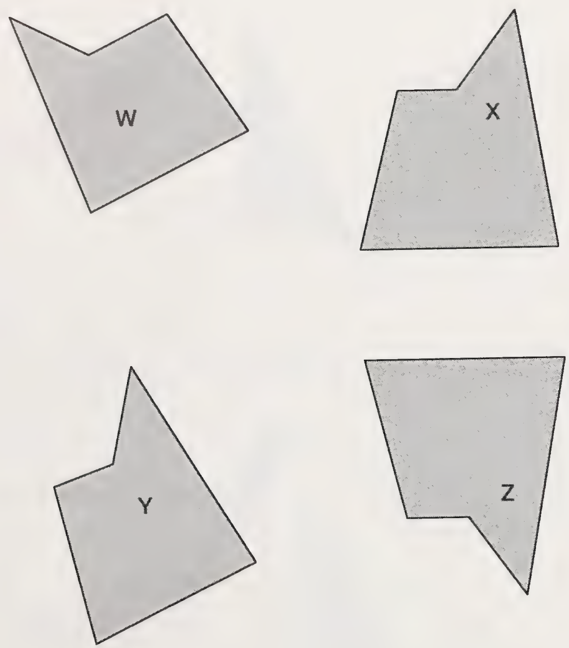
1. Use tracing paper to compare the figures. Circle the congruent figures.

   a.



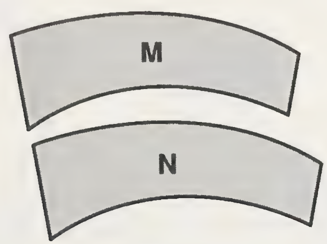
Space for Your Work

b.



Space for Your Work

2. Is the following pair of figures congruent? Be sure to test with tracing paper. You may be surprised.

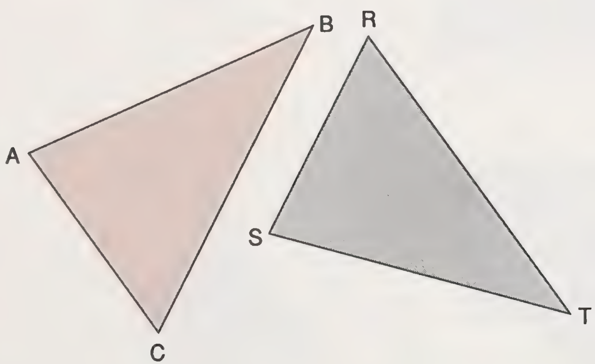


See your learning facilitator to check your answers and to receive further instructions.

Working Together

Figures that have the same shape and size are called **congruent figures**.

Look at these figures.



A tracing of triangle ABC fits triangle RST.

So the triangles are congruent.

The symbol for *is congruent to* is $\cong$.

For this fitting the vertices are matched this way.

$A \cong S$

$B \cong T$

$C \cong R$

The sides and angles that match are called **corresponding parts**. For a congruent fitting, the corresponding parts are congruent.

Congruent Angles	Congruent Sides
$\angle A \cong \angle S$	$\overline{AB} \cong \overline{ST}$
$\angle B \cong \angle T$	$\overline{BC} \cong \overline{TR}$
$\angle C \cong \angle R$	$\overline{CA} \cong \overline{RS}$

So $\Delta ABC \cong \Delta STR$.

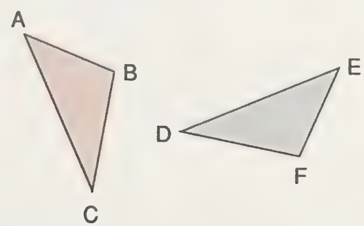
Notice the corresponding vertices are named in order.

Concluding Activities

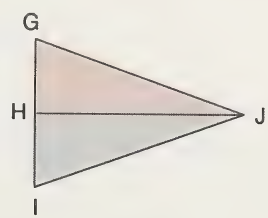
Space for Your Work

Complete the following.

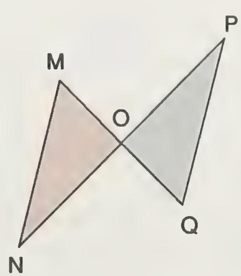
1.



2.



3.



1. a. $\angle A \cong$ ________ d. $\overline{AB} \cong$ ________

   b. $\angle B \cong$ ________ e. $\overline{AC} \cong$ ________

   c. $\angle C \cong$ ________ f. $\overline{BC} \cong$ ________

   $\Delta ABC \cong$ ________

2. a. $\angle G \cong$ ________ d. $\overline{DJ} \cong$ ________

   b. $\angle GHJ \cong$ ________ e. $\overline{GH} \cong$ ________

   c. $\angle GJH \cong$ ________ f. $\overline{HJ} \cong$ ________

   $\Delta GHJ \cong$ ________

3. a. $\angle M \cong$ ________ d. $\overline{MO} \cong$ ________

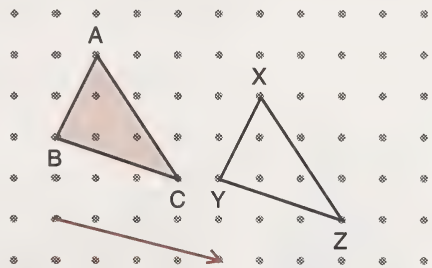
   b. $\angle N \cong$ ________ e. $\overline{MN} \cong$ ________

   c. $\angle MON \cong$ ________ f. $\overline{MO} \cong$ ________

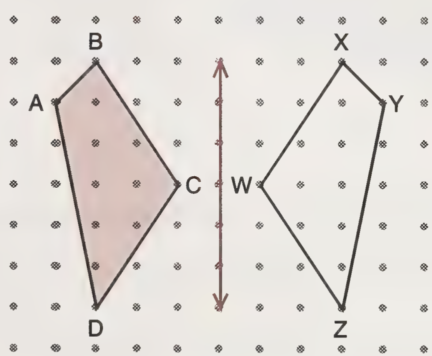
   $\Delta MNO \cong$ ________

4. You can use slides, flips, and turns to determine if figures are congruent. In each of the following identify the corresponding sides and corresponding angles.

a.



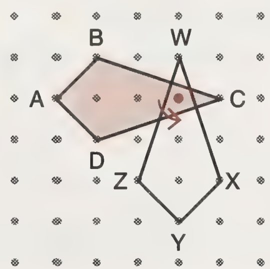
b.



Space for Your Work

Space for Your Work

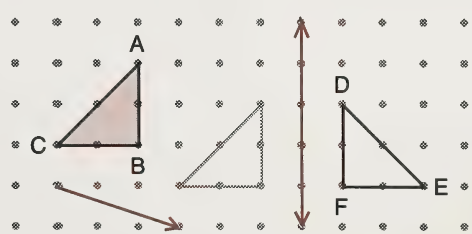
c.



5. Sometimes a series of slides, flips, or turns has been made.

Example

Triangles ABC and DEF are congruent. You can slide triangle ABC and then flip it onto triangle DEF.



For the following, identify the corresponding sides, corresponding angles, and vertices.

Computer Alternative

6. If you want to play a challenging game comparing figures using slides, flips, and turns, play "Slides, Flips and Turns" on Disk C of MAC 6.

Space for Your Work

See your learning facilitator to check your answers and to receive further instructions.

SIMILAR FIGURES

What Lies Ahead

In this section you will learn these skills.

- interpreting what is meant by similar figures
- testing if two figures are similar

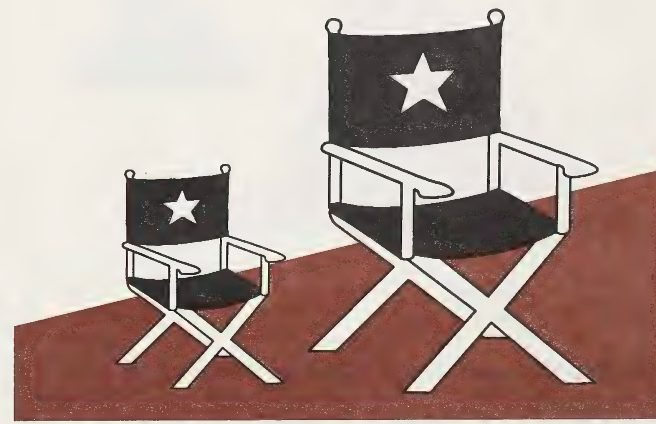
In this section you will learn these words.

- similar
- similarity

Working Together

In the previous section you learned about **congruent** figures.

Look at these two chairs.



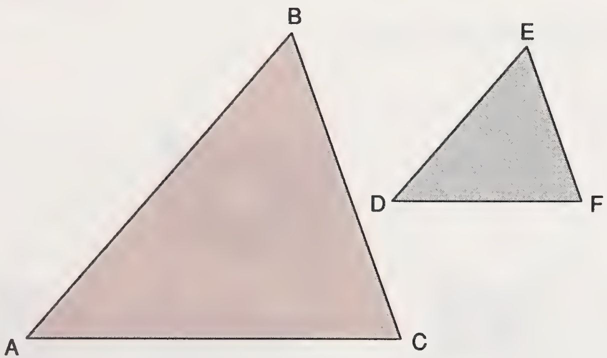
These chairs are not congruent. They have the same shape, but they are different sizes.

Objects which have the same shape but not the same size are called **similar objects**.

Introductory Activities

Space for Your Work

The following figures are similar.



1. Measure the corresponding angles with a protractor.

   a. $\angle A$ and $\angle D$

   b. $\angle B$ and $\angle E$

   c. $\angle C$ and $\angle F$

Space for Your Work

2. Measure the size of the corresponding sides with a metric ruler.

   a. $\overline{AB}$ and $\overline{DE}$

   b. $\overline{BC}$ and $\overline{EF}$

   c. $\overline{AC}$ and $\overline{DF}$

3. Calculate the ratios of the corresponding sides.

   a. $\overline{AB}$ to $\overline{DE}$

   b. $\overline{BC}$ to $\overline{EF}$

   c. $\overline{AC}$ to $\overline{DF}$

4. What can you conclude about similar figures?

See your learning facilitator to check your answers and to receive further instructions.

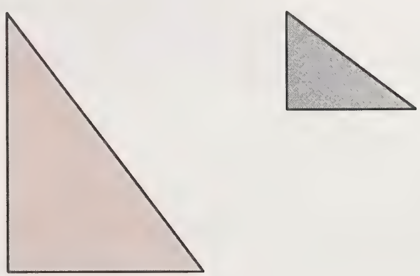
Working Together

Tracing Paper Tests for Similarity

You can use tracing paper to test figures to see if they are similar.

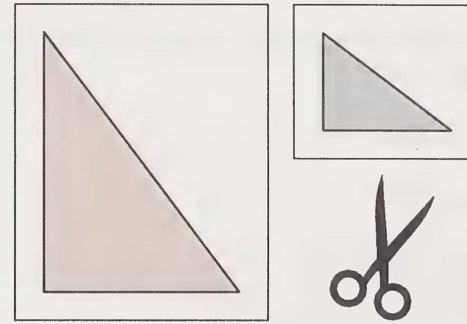
Example 1

Are these figures similar?

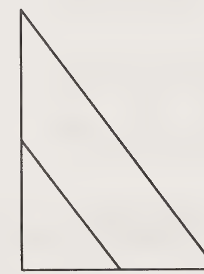


Solution

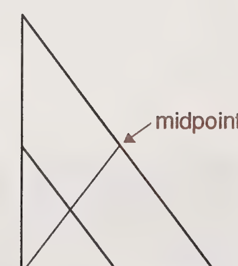
Step 1: Trace the three figures. Cut out the tracings.



Step 2: Stack the tracings.



Step 4: If the figures are similar a line can be drawn from the vertex to the opposite vertices.



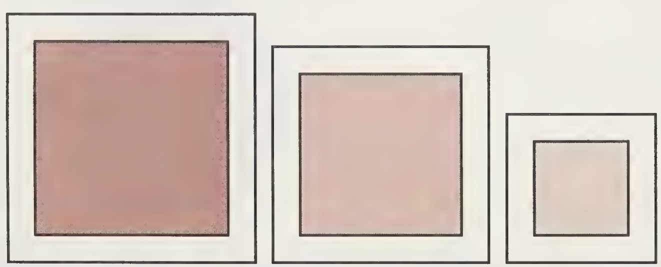
The figures are similar.

Example 2

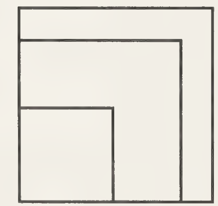
Are these figures similar?

Solution

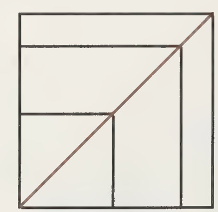
Step 1: Trace the two figures. Then cut out the tracings.



Step 3: Move the tracing of one triangle over the tracing of the other figures. (In this case, you will have to flip on of the tracings.)



Step 4: If the figures are similar a line can be drawn from the vertex to the midpoint of the third sides. (You can find the midpoint by folding the sides in half.)



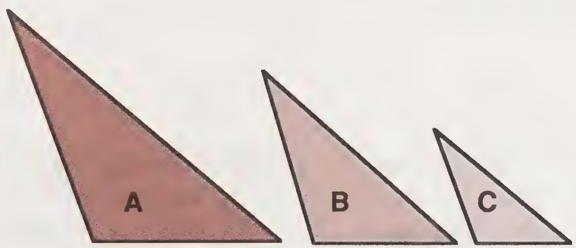
The figures are similar.

Practice Activities

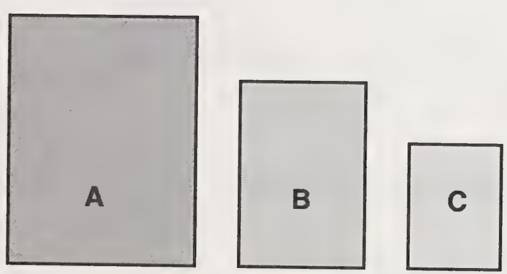
Space for Your Work

Which of these figures are similar? (Use tracing paper to test.)

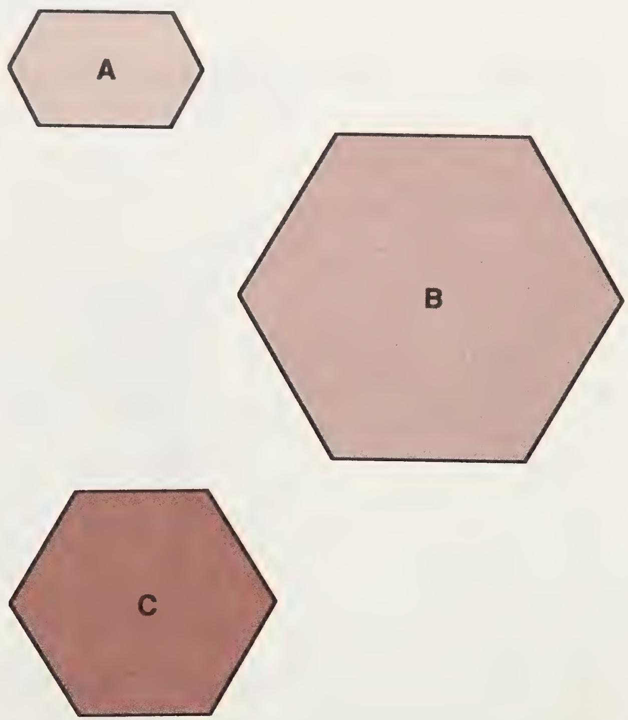
1.



2.



3.



Space for Your Work

See your learning facilitator to check your answers and to receive further instructions.

Concluding Activities

Space for Your Work

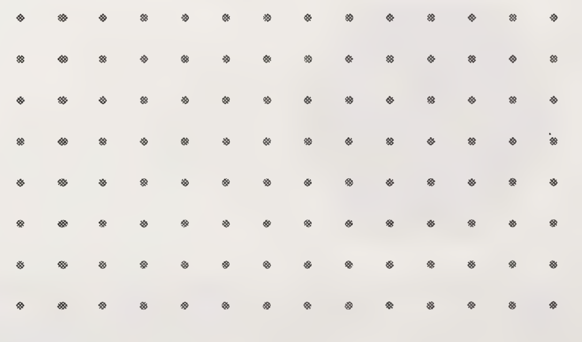
1. With dot paper it is easy to draw similar figures.

   On the dot paper at the right draw figures that are similar to the following.

   a. 

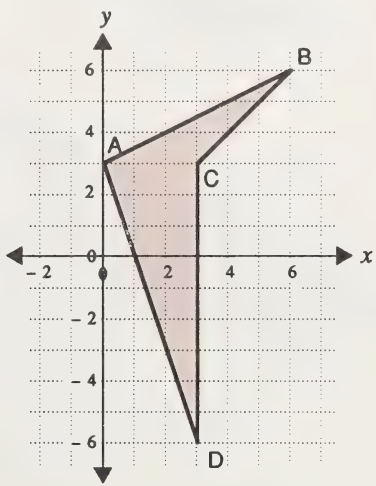
   b. 

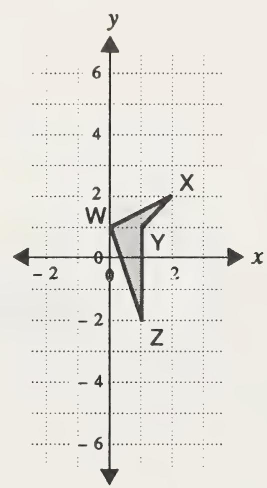
1\. a. 

b. 

2. With graph paper it is also easy to compare similar figures.

a. Name the coordinates of these two figures in the charts to the right.





b. What do you notice about the corresponding coordinates?

Space for Your Work

1. a.

Large Figure

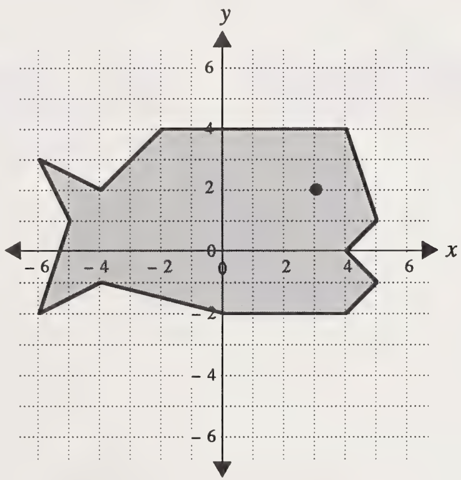
vertex	coordinates
A	
B	
C	
D	

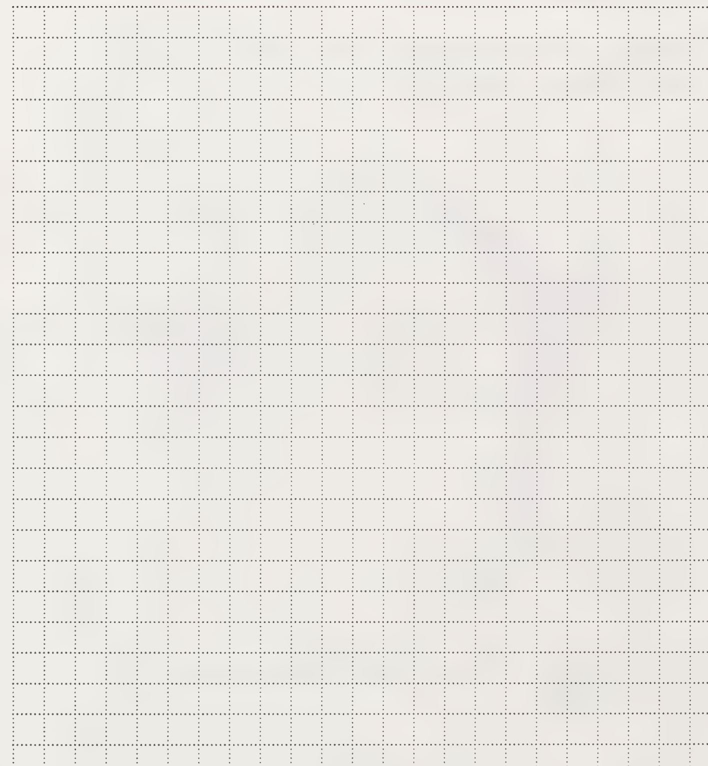
Small Figure

vertex	coordinates
W	
X	
Y	
Z	

Space for Your Work

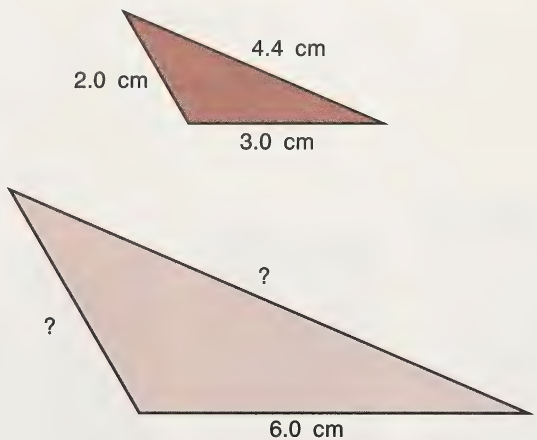
3. Draw a figure similar to this using the graph paper.





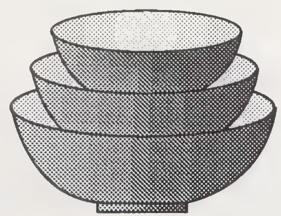
Space for Your Work

4. These triangles are similar. Calculate the missing lengths. Do not measure.



Space for Your Work

5. These stacking bowls are similar. Their diameters are 15 cm, 18 cm, and 21 cm. The largest bowl is 7 cm deep. How deep are the others?



Space for Your Work

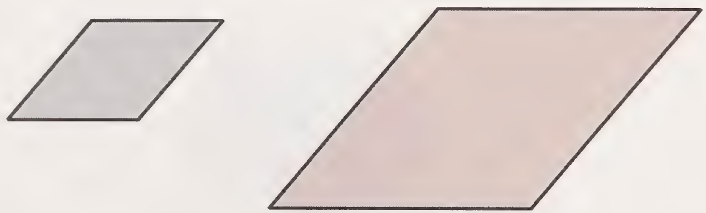
6. These canisters are similar. The sugar canister is 16 cm wide and 20 cm high.

   a. The tea canister is 12 cm wide. How high is it?

   b. The flour canister is 20 cm wide. How high is it?

Space for Your Work

7. These figures are similar. Give the measure of the angles in the second figure. Do not use a protractor.



See your learning facilitator to check your answers and to receive further instructions.

FLIP SYMMETRY

What Lies Ahead

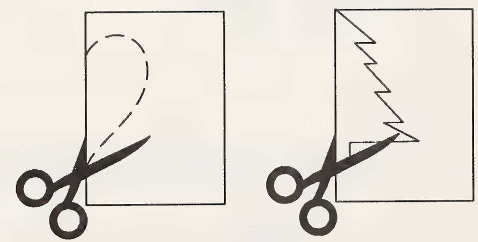
In this section you will learn to test a figure for flip symmetry.

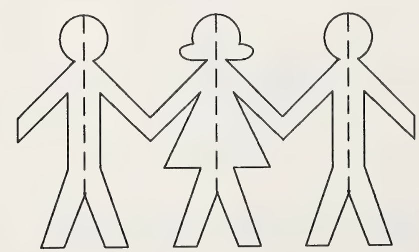
In this section you will learn these words.

- flip symmetry
- line of symmetry

Working Together

Have you ever cut out hearts, trees, or dolls from folded paper?

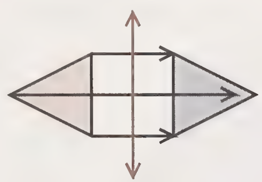




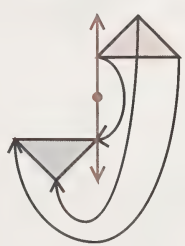
When you did this, you always ended up with congruent shapes on either side of the fold line.

As you learned earlier, there are three different ways to show that two figures are **congruent**.

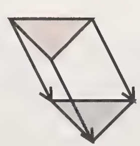
- You can flip one figure onto another.



- You can turn one figure onto another.

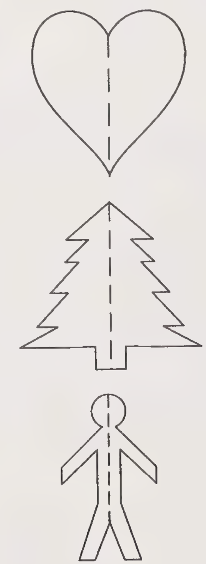


- You can slide one figure onto another.



The figures on the previous page have **flip symmetry**. Half of the figure can be flipped onto the other half of the figure.

This symmetry is sometimes called **reflection symmetry**.

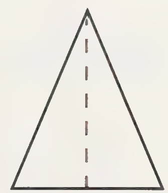


The flip line is the **line of symmetry**. The parts of the figures on either side of the flip line are **congruent**.

Flip symmetry is often called **line symmetry**.

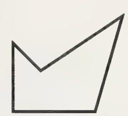
Lines of Symmetry

This figure can be divided into 2 congruent parts by a line. It has flip symmetry.



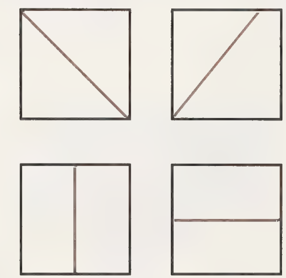
The figure has 1 line of symmetry.

This figure can **not** be divided into 2 congruents by a line. It does not have flip symmetry.



The figure has 0 lines of symmetry.

There are 4 ways that this figure can be divided into congruent parts by a line. It has flip symmetry.



The figure has 4 lines of symmetry.

Tracing-Paper Tests for Flip Symmetry

You can test for flip symmetry using tracing paper.

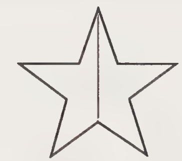
Example

Does this star have flip symmetry?

Solution

Step 1: Trace the figure and cut out the tracing.

Step 2: Fold the cutting so that the left side matches the right side.



Step 3: The fold line is the line of symmetry.

There are actually 5 lines of symmetry in this star.

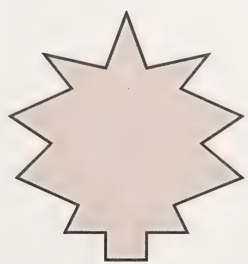
Yes, this star has flip symmetry.

MIRA Tests for Flip Symmetry

A MIRA (an instrument made from plexiglass) can be used to test for flip symmetry.

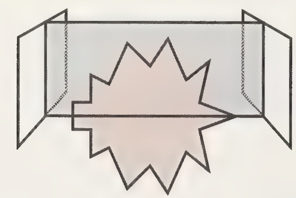
Example

Does this leaf have flip symmetry?



Solution

Place the MIRA on the figure. If the MIRA reflects one half of the leaf exactly on the other half, the leaf has flip symmetry.



The leaf has flip symmetry.

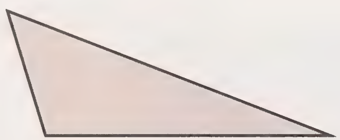
Note

The MIRA is on the line of symmetry.

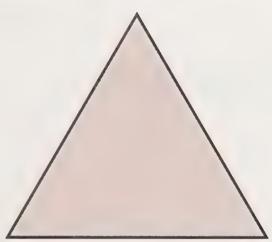
Practice Activities

Space for Your Work

1. Do the following figures have flip symmetry? If so, draw the lines of symmetry. Using the tracing paper provided at the end of this booklet.

   a. 

   b. 

   c. 

Space for Your Work

2. Do the following letters have flip symmetry? Use a MIRA to test for flip symmetry.

   a. L

   b. E

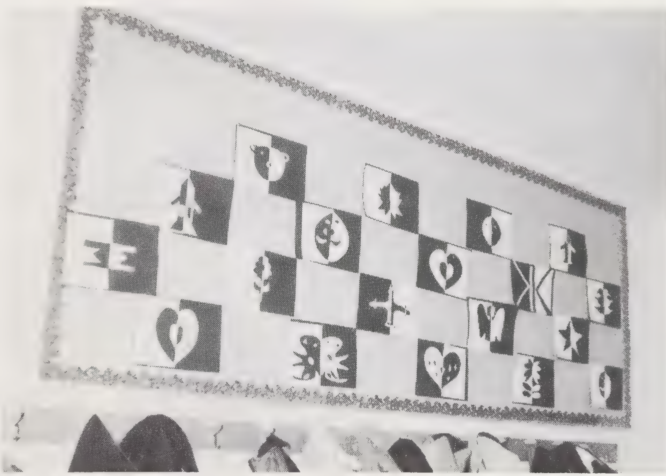
   c. H

   d. N

See your learning facilitator to check your answers and to receive further instructions.

Working Together

Many interesting designs can be created using flip symmetry.



You can use folding, tracing paper, or a MIRA to create these designs.

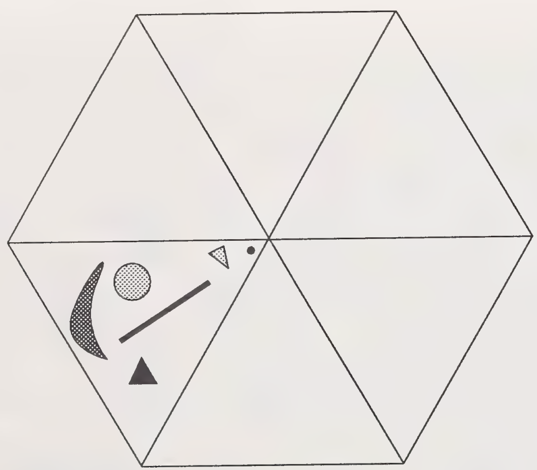
Concluding Activities

Space for Your Work

1. Make a design of your own using flip symmetry.

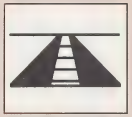
Space for Your Work

2. Complete this pattern. The lines are lines of symmetry. Use a MIRA to help you.



See your learning facilitator to check your answers and to receive further instructions.

TURN SYMMETRY



What Lies Ahead

In this section you will learn to test figures for turn symmetry.

In this section you will learn these words.

- turn symmetry
- point of symmetry
- order of turn symmetry

Working Together

In the previous section you learned about flip symmetry. If a figure has **flip symmetry** a flip line, **line of symmetry**, divides the figure into two congruent parts. Flip symmetry makes the figure look balanced.

In this section you will learn about another kind of symmetry, turn symmetry.

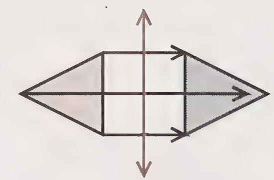
When you were younger did you ever play with a toy windmill on a stick?

The toy windmill has blades similar to that of a fan or propeller. When a child holds up the toy windmill the wind makes it whirl.

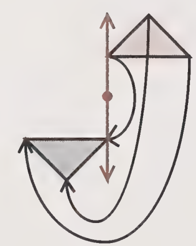
The toy windmill does not have flip symmetry. It cannot be divided into 2 congruent parts with a line.

However, as you learned earlier there are 3 ways to show congruence.

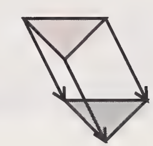
- You can flip one figure onto the another.



- You can turn one figure onto another.

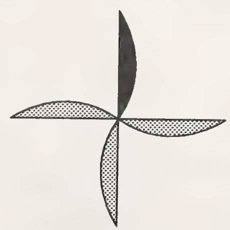


- You can slide one figure onto another.



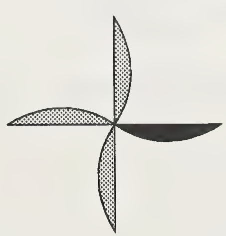
Can the windmill be turned around its centre in such a way that it is in the same position more than once in a full turn?

It is difficult to keep track of the positions as the toy turns, so it helps to colour or mark the object.



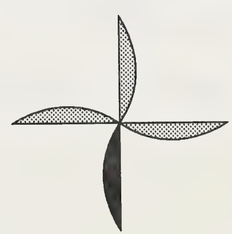
starting position

1



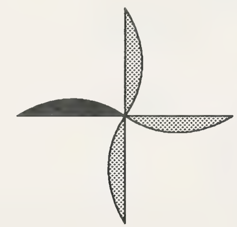
$\frac{1}{4}$ turn

2



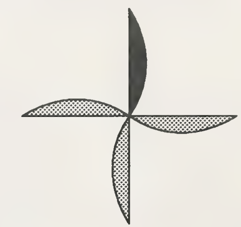
$\frac{1}{2}$ turn

3



$\frac{3}{4}$ turn

4



1 full turn

Yes, in one full turn the windmill is in the same position 4 times.

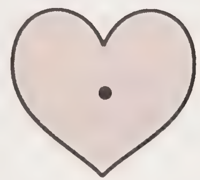
A figure has **turn symmetry**, if the figure fits on itself after a turn other than a full turn.

The windmill has turn symmetry. This makes the toy look balanced.

The windmill's **order of turn symmetry** is 4. That means the windmill fits on to itself 4 times in a full turn.

Turn symmetry is sometimes called **rotational symmetry**.

Does the following figure have turn symmetry? If so, what is its order of turn symmetry?



starting position

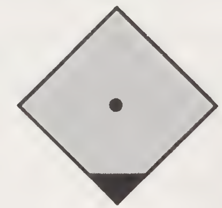
No, this figure does not have turn symmetry.

In 1 full turn the heart is in exactly the same position only once.

Does this figure have turn symmetry? If so, what is its order of turn symmetry?

starting position

1



$\frac{1}{2}$ turn

2

1 full turn

This figure has turn symmetry.

In 1 full turn the figure is exactly in the same position 2 times. Its order of turn symmetry is 2.

Note

The **turn centre** is the **point of symmetry**.

Turn symmetry is often called **point symmetry**.

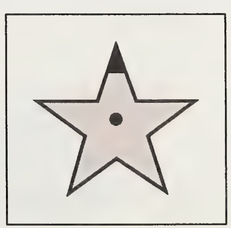
Tracing-Paper Tests for Turn Symmetry

You can use tracing paper and a pin to test for turn symmetry.

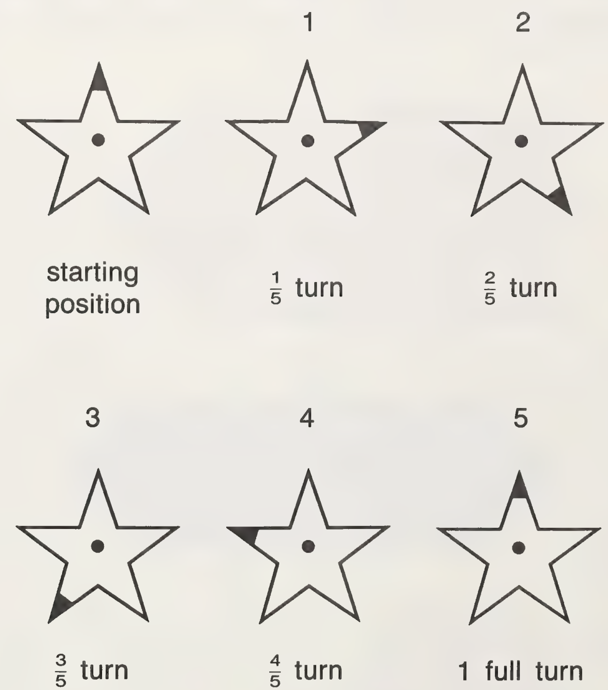
Example

Does this star have turn symmetry?

Step 1: Trace the figure and put a pin in the centre. Put a mark on the figure.



Step 2: Turn the traced figure about the centre. You will find that the start has turn symmetry.



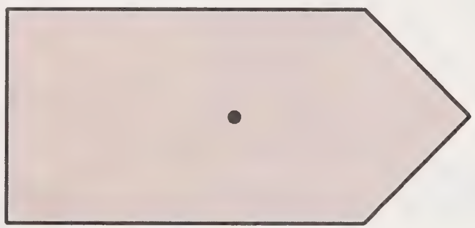
The star's order of turn symmetry is 5. That is, the star fits onto itself 5 times in 1 full turn.

Practice Activities

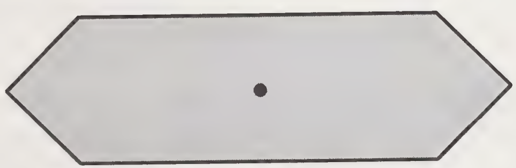
Space for Your Work

Do the following figures have turn symmetry? If so, give the order of turn symmetry. Use tracing paper provided at the end of this booklet and a pin to test the figures.

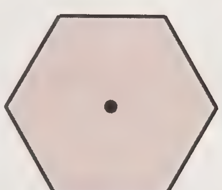
1.



2.



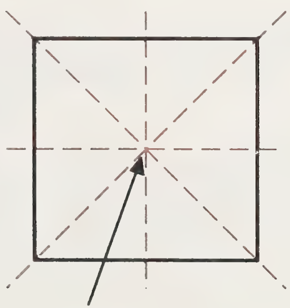
3.



Space for Your Work

4. Turn centres for any polygon of Order 2 or more may be located by finding the point of intersection of the lines of symmetry. Study these examples.

Square: Order 4



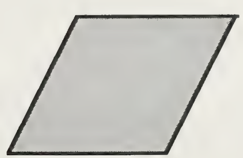
turn centre

Star: Order 5

turn centre

Find the turn centre and the order of turn symmetry for each figure below.

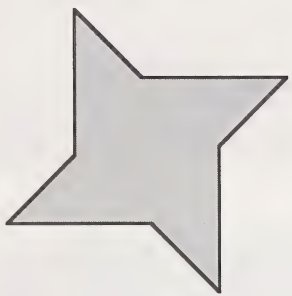
a.



Space for Your Work

b.

c.



5. Which of the capital letters have half-turn symmetry?

6. The numeral 1961 has half-turn symmetry. Can you find other numerals with half-turn symmetry?

See your learning facilitator to check your answers and to receive further instructions.

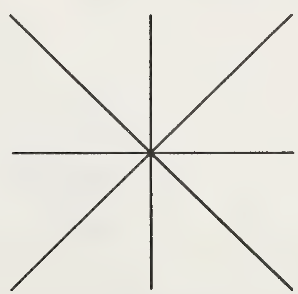
Working Together

You can make designs with turn symmetry.

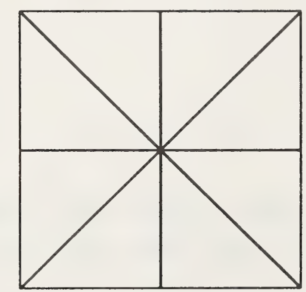
Example

Suppose you want to make a design that fits onto itself 8 times in 1 full turn. You would follow these steps.

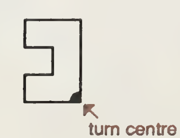
Step 1: Pick a turn centre on a piece of piece of paper and draw 8 equal angles about the turn centre. Use a protractor.



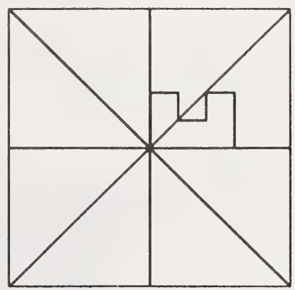
Step 2: Tape a piece of tracing paper over the other piece of paper.



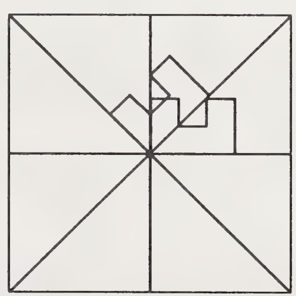
Step 3: Draw a figure to be rotated on a stiff piece of paper and cut out the figure to make a template. Indicate the turn centre of the figure.



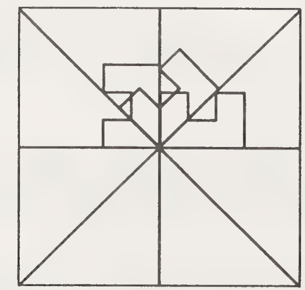
Step 4: Place the turn centre of the template on the turn centre of the paper and align the figure with one of the rays of the angles. Then trace the template.



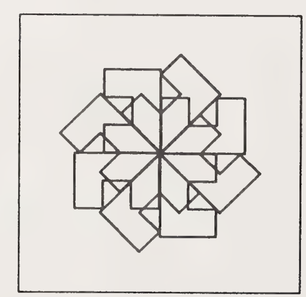
Step 5: Turn the template until it aligns with another ray. Then trace the template.



Step 6: Turn the template until it aligns with another ray. Then trace the template.



Step 7: Continue turn the template and tracing it. Then remove the template and take off the tracing paper. The design on the tracing paper looks like this.



Notice that if you were to turn this design it would fit onto itself 8 times in 1 full turn. It has a turn order of 8.

Concluding Activities

Space for Your Work

Make a design with turn symmetry. It should have a turn order of 4 or greater.

See your learning facilitator to check your answers and to receive further instructions.

TILING PATTERNS

What Lies Ahead

In this section you will learn to make tiling designs using dot paper and pattern blocks.

In this section you will learn these words.

- tiling
- tesselation

Working Together

This section deals with tiling designs.

Tiling is the process of using congruent shapes to cover a region completely and without overlap.

Tiling has a very long history.

About 6000 years ago the Sumerians built homes and temples decorated with slabs of burnt clay called tiles. They coloured these tiles with patterns.

The Romans also used tiles in buildings, floors, and pavements. The Romans called them "tessellae." This is the origin of the word "tesselation" which is used today.

Today, builders still use tiling patterns.

WESTFILE INC.

Tiling patterns can be made with only one shape.

Example

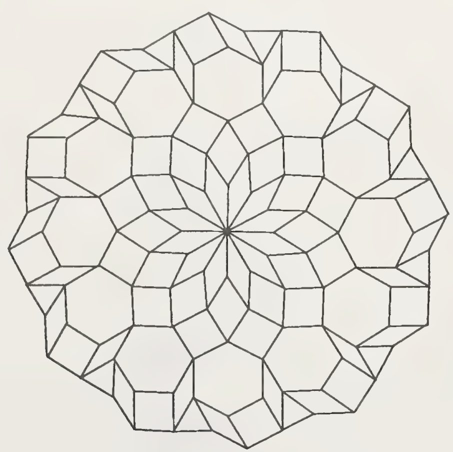
Remember, in the tiling process, shapes cover a region completely and not shapes overlap.

A tiling pattern with only one shape is a **tesselation**.
A shape that will make a tiling pattern will **tesselate**.

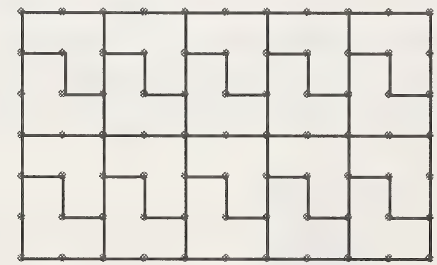
Tiling patterns can be made with more than one shape.

Examples

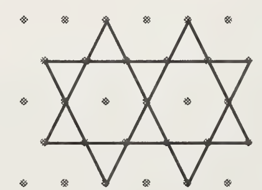
- This tiling pattern is made with pattern blocks.



- This tiling pattern is made with square dot paper.

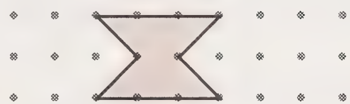


- This tiling pattern can be made on triangular dot paper.



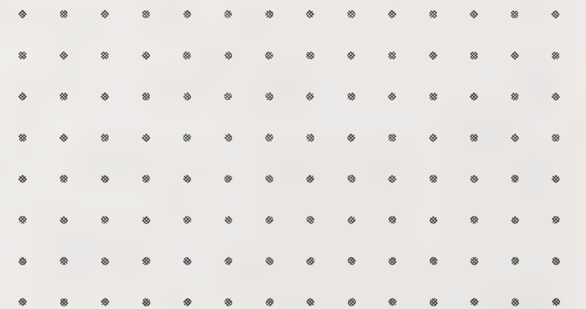
Practice Activities

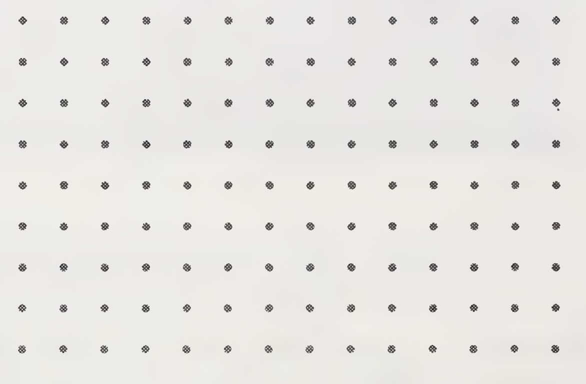
1. Will each of the following figures tesselate? Remember a tesselation is a tiling pattern with only one shape and in the tiling process the region is covered completely without overlap. Support your answers by using the dot paper at the right.

   a. 

   b. 

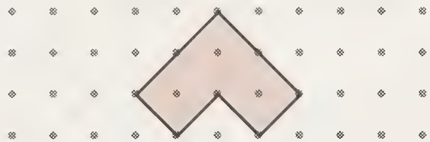
Space for Your Work

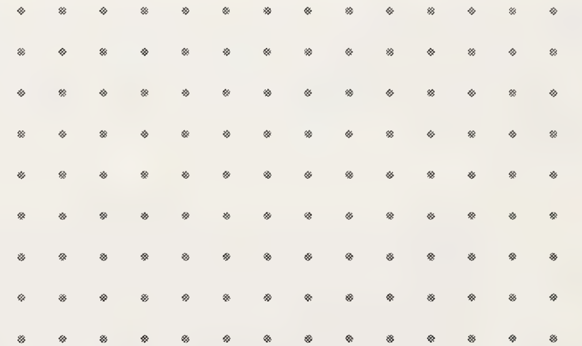
1. a. 

   b. 

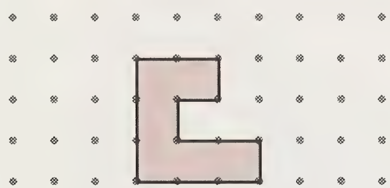
Space for Your Work

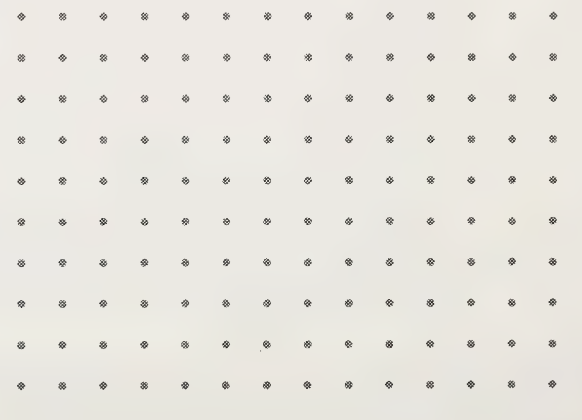
c.





d.





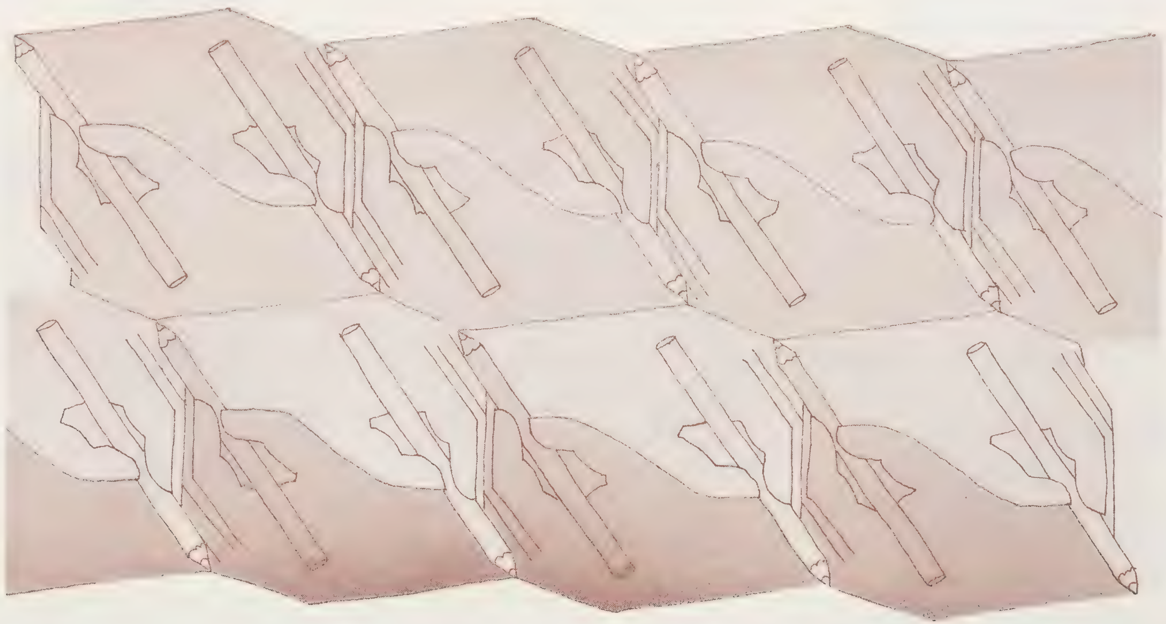
Space for Your Work

2. Make a tiling pattern of your own with more than one shape. Use pattern blocks, square dot paper, or triangular dot paper provided at the end of the booklet. Tape the design in the space provided on this page.

See your learning facilitator to check your answers and to receive further instructions.

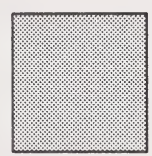
Working Together

Examine this unique tesselation.

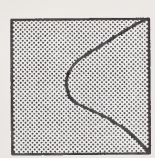


You can create a rather unique tesselation (tiling pattern with one shape) using the method described below.

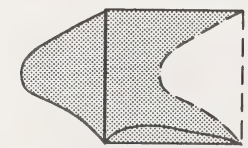
Step 1: Start with a shape you know will tesselate and make a template on stiff paper. The example uses a square.



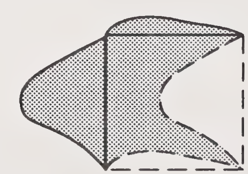
Step 2: Cut a chunk out of the shape.



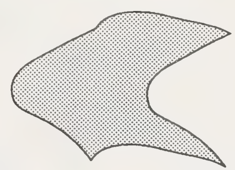
Step 3: Slide the chunk to the left and tape it.



Step 4: Cut a chunk out of another side of the square.

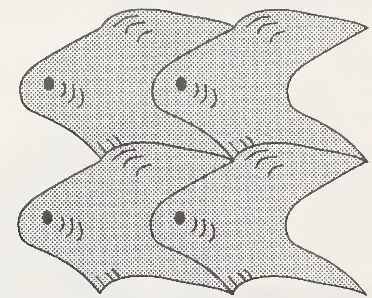


Step 5: Slide the chunk to the left and tape it.



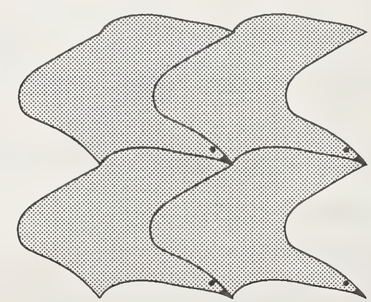
Step 6: Try to imagine what your template represents. (Does it look like a fish or a wild goose?)

Step 7: Position the template and cover the page by tesselating the shape. Afterwards, colour the design to illustrate what you imagined the shape to be.



School of fish

OR



Wild geese

Concluding Activities

Space for Your Work

1. Make a unique tesselation at the right using the method described in "Working Together." You can use the stiff paper provided at the end of this booklet.

2. An artist named M.C. Escher (1898-1972) was famous for his tesselations and tilings. View some of his interesting designs. They can be found in the following books:

   Journeys in Math 7 (Ginn, 1987), page 374

   Journeys in Math 8 (Ginn, 1987), pages 392 and 393

   Mathways 8 (Copp, Clark, Pitman, 1980), pages 110 and 117

   Houghton Mifflin Mathematics 7 (1985), page 139

   Holt Math 7 (1984), page 342

See your learning facilitator to check your answers and to receive further instructions.

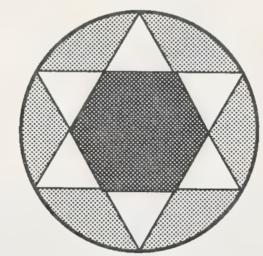
COMPASS DESIGNS

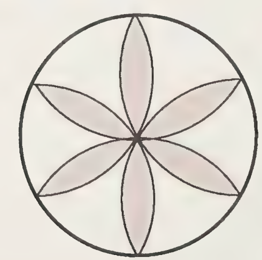
What Lies Ahead

In this section you will learn to make geometric designs using a compass.

Working Together

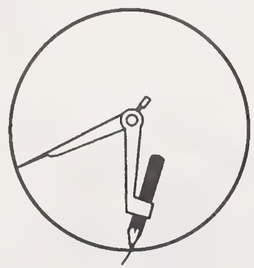
In this section you will be making designs like these using a compass.



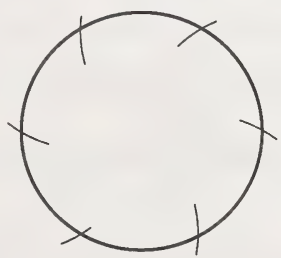


The first design in "Working Together" was made using these steps.

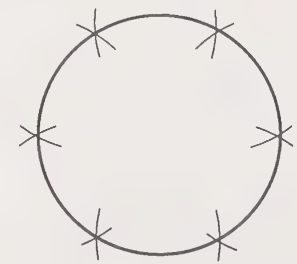
Step 1: Make a circle with a compass.



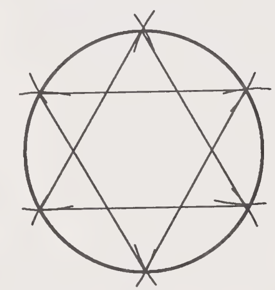
Step 2: Do not change the compass setting. Begin on any point on the circumference of the circle. Make an arc cutting the circle.



Step 3: Do not change the setting of the compass. Put the compass point on the point where the arc cuts the circle and make another arc. Repeat this step until you have 6 arcs.



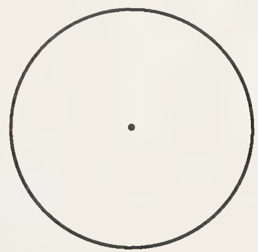
Step 4: Use a ruler to join the points where the arcs cut the circle.



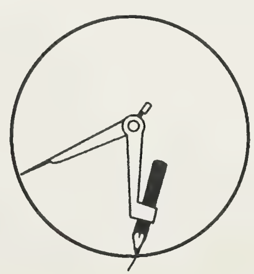
Step 5: Colour the design.

The second design in “Working Together” was made using these steps.

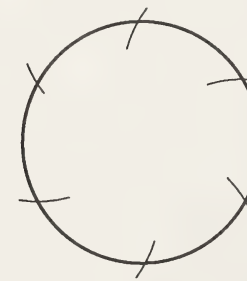
Step 1: Make a circle with a compass.



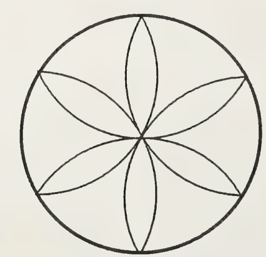
Step 2: Do not change the compass setting. Begin on any point on the circumference of the circle and make an arc that cuts the circle.



Step 3: Do not change the setting of the compass. Put the compass point on the point where the arc cuts the circle and make another arc. Repeat this step until you have 6 arcs.



Step 4: Put the compass on the point where an arc cuts the circle. Draw an arc which connects 2 of the other arcs. Move the compass to the next point where an arc cuts the circle and repeat this step until all the arcs are joined.



Step 5: Colour the design.

Practice Activities

Space for Your Work

1. Make a design like the first design in ‘‘Working Together.’’ Use the first set of directions.

Space for Your Work

2. Make a design like the second design in "Working Together." Use the second set of directions.

3. Make a compass design of your own and colour it.

Space for Your Work

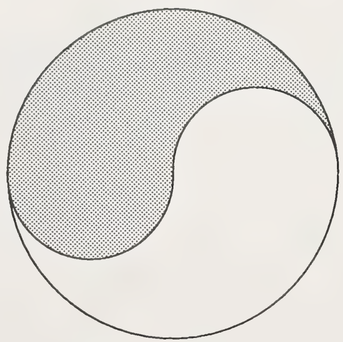
See your learning facilitator to check your answers and to receive further instructions.

Concluding Activities

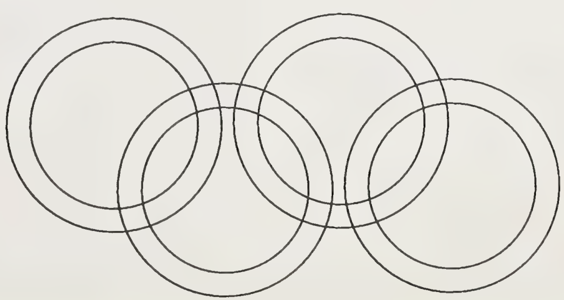
Space for Your Work

Make the following geometric designs using a compass.

1.

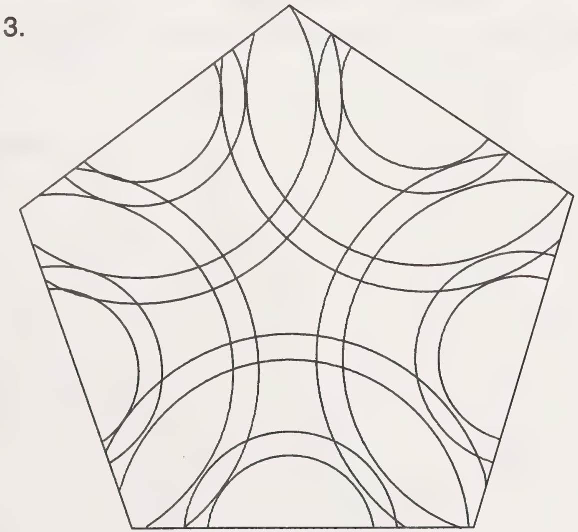


2.



Space for Your Work

3.



See your learning facilitator to check your answers and to receive further instructions.

LOGO DESIGNS

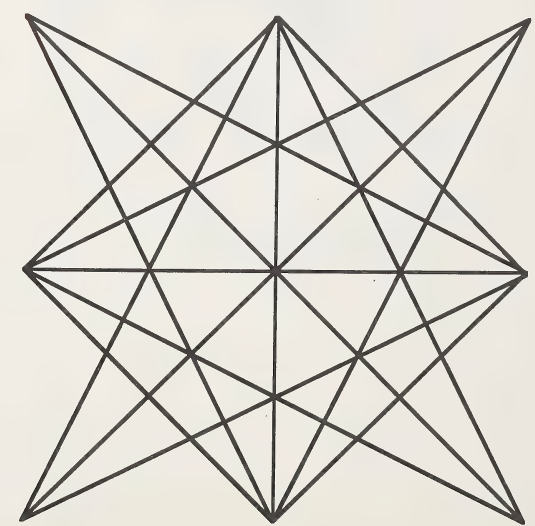
What Lies Ahead

In this section you will learn to make geometric designs using a computer.

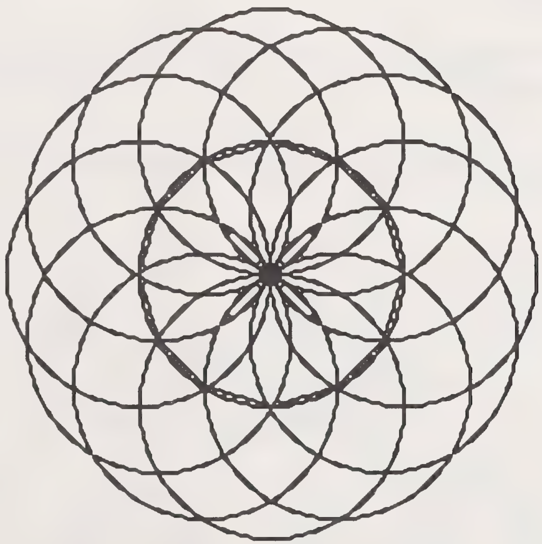
Working Together

Many interesting geometrical designs can be made with a computer.

Here is an example of a computer design make with straight lines.



Here is an example of a computer design using circles.



These two geometrical designs were made using commands in the computer language, **LOGO**.

Computer Activity

If you have access to a computer, turn to the *LOGO Booklet* and do the activities. You will need an Apple LOGO program and a blank disk.

What Lies Ahead

In this section you will review these concepts.

- slides, flips, turns
- congruent figures
- similar figures
- flip and turn symmetry
- tiling
- tesselation
- geometric designs

Working Together

At this point, it may be a good idea to review the skills you have learned in Part Two.

Turn to Section 14 and review the Pretest. Then correct any errors you may have made at the time. You may be pleasantly surprised to discover how much you have learned!

MODULE CONCLUSION

What Lies Ahead

The assignment in the Module Conclusion evaluates the achievements of the objectives in this module.

Working Together

Now that you have studied Module 6 and you have done the required practice, you should be ready for the module assignment.

Module Assignment

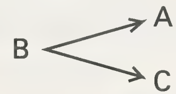
Turn to the Assignment Booklet and complete the module assignment independently. You may refer to your notes, but do not get help from anyone.

Afterwards, submit the Assignment Booklet for a grade and feedback from your teacher.

APPENDIX

GLOSSARY

Angle: two rays which meet at a common point

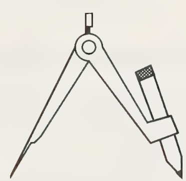


Area: the measure of a region in square units

Capacity: the amount a container can hold

Clockwise turn: a turn in the direction which the hands of a clock turn

Compass, pair of compasses: an instrument used for drawing circles and arcs



Congruence, congruency: the property of being congruent, matching exactly, being equal in every respect

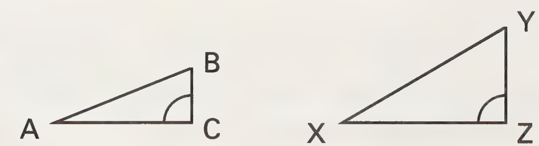
Congruent angles: angles having the same size

Congruent figures: geometric figures that have the same size and shape

Congruent sides: sides having the same length

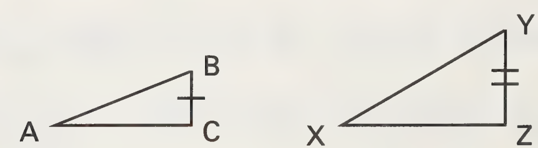
Congruent symbol: $\cong$

Corresponding angles (of congruent figures): two angles that match and are congruent



$\angle C \cong \angle Z$

Corresponding sides (of congruent figures): two sides that match and are congruent



$\overline{BC} \cong \overline{YZ}$

Counterclockwise turn: a turn in the opposite direction to which the hands of a clock turn

Cubic unit: a unit of volume

Deca-: metric prefix meaning 10

Deci-: metric prefix meaning $\frac{1}{10}$

Degree (of an angle): a unit for measuring angles

Degree symbol: °

90°

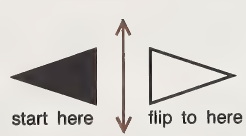
Dimension: the measurement of length, width, or height (depth, thickness)

Equivalent measures: measurements that are the same size

1000 m = 1 km

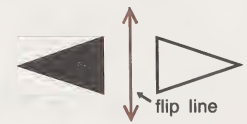
Estimation: in geometry, an educated guess

Flip: a rigid motion that occurs when a shape is flipped over a line



Flip image: the figure that results from a flip

Flip line: a line that defines a flip (Each point of the shape and its matching point in the flip image is equidistant from the flip line.)



Flip symmetry: the property of being symmetrical, able to be divided into two congruent parts that are flip images of each other

Hecto-: metric prefix meaning 100

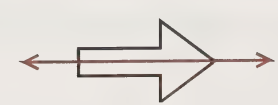
Image: the figure that results from a flip, slide, or turn

Kilo-: metric prefix meaning 1000

Length: a measured distance Also the longest dimension of a figure.

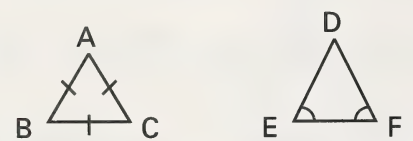
Linear unit: a unit of length

Line of symmetry: a line that divides a figure into two congruent parts that are flip images of each other



Mass: the amount of matter in an object

Matching marks: symbols used to identify congruent sides or congruent angles



$\overline{AB} \cong \overline{BC} \cong \overline{AC}$ $\angle E \cong \angle F$

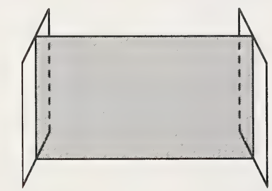
Measure: the amount found by measuring

Measurement: the process of finding out how many measuring units are in something. Also the amount found by measuring.

Metric system: the system of weights and measures based on the metre as a standard of measurement

Milli-: a metric prefix meaning $\frac{1}{1000}$

MIRA: a mathematical tool made of plexiglass; a transparent plastic mirror



Order of turn symmetry: the number of times a figure fits onto itself in one full turn

Perimeter: the distance around a figure

Point of symmetry: a point about which a figure can be turned so that it fits onto itself more than once in a full turn

Precision: the accuracy with which something is measured

Protractor: a mathematical instrument for measuring angles

Reflection: see flip

Rotation: see turn

Side: a line segment joining two vertices of a figure

Similar figures: figures that have the same shape but not necessarily the same size

Similarity: the property of being the same shape but not necessarily the same size

Sketch: a drawing that is not drawn to scale

Slide: a rigid motion that occurs when each point in a shape is moved the same distance and in the same direction

Slide arrow: an arrow that defines the slide. It shows the distance and direction of the slide.

Slide image: the figure that results from a slide

Square unit: a unit for measuring area

Standard (of measurement): something set up by authority as a rule for the measuring

Tesselation: a tiling pattern with one shape

Three dimensional: having length, width, and height

Tiling: the process of using congruent shapes to cover a region completely and without overlap

Translation: see slide

Turn: a rigid motion in which the points of a shape are turned about a fixed point

Turn angle: an angle that defines the turn. It tells the direction and angle of turn.

Turn centre: the vertex of a turn angle

Turn image: the figure that results from a turn

Turn symmetry: the property of being symmetrical, able to be turned as the figure fits onto itself more than once in a full turn

Two dimensional: having length and width

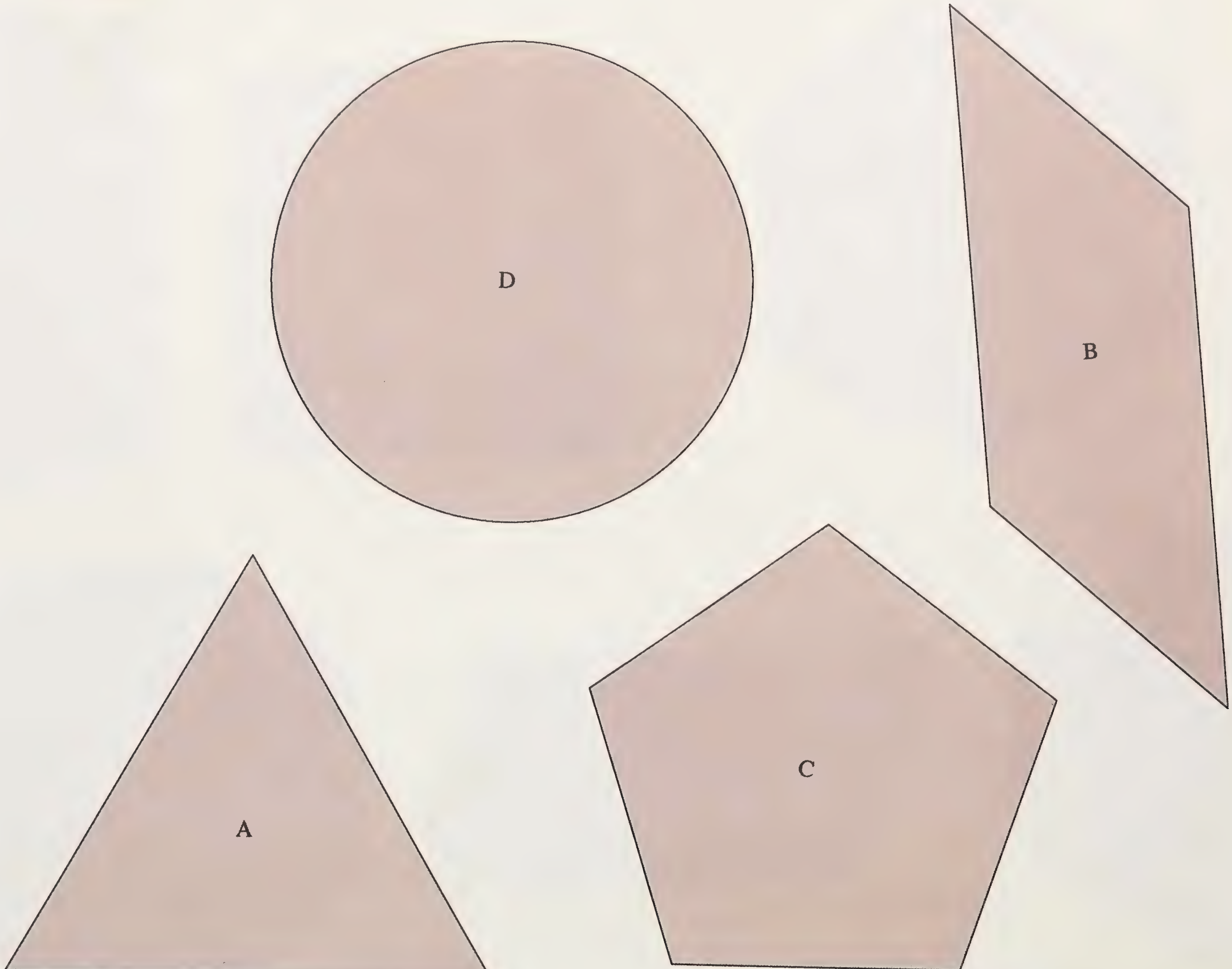
Unit: a standard of measurement such as a centimetre, metre, or kilometre

Vertex (of a figure): the common endpoint of two sides of a figure

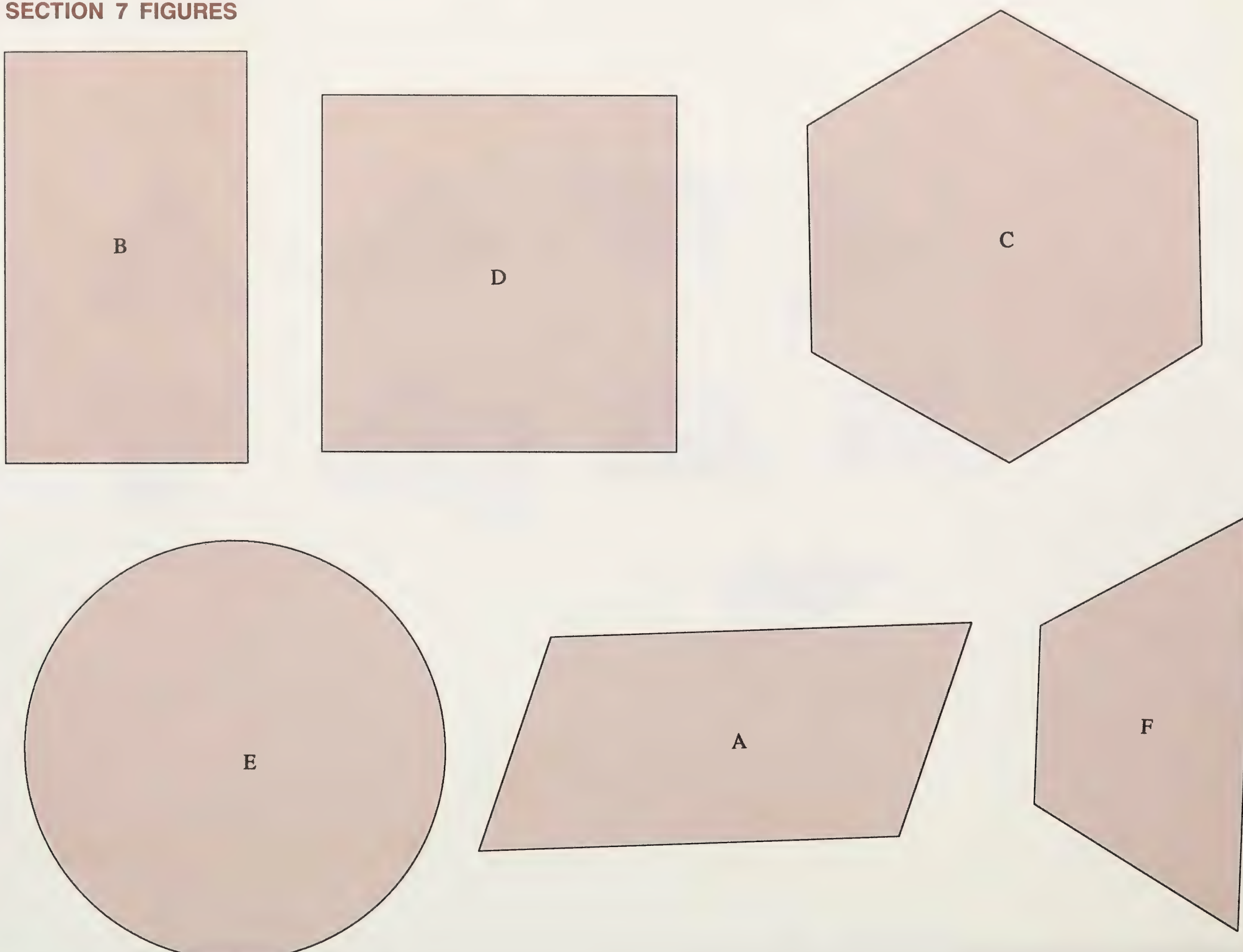
Vertex (of an angle): the common endpoint of two rays of an angle

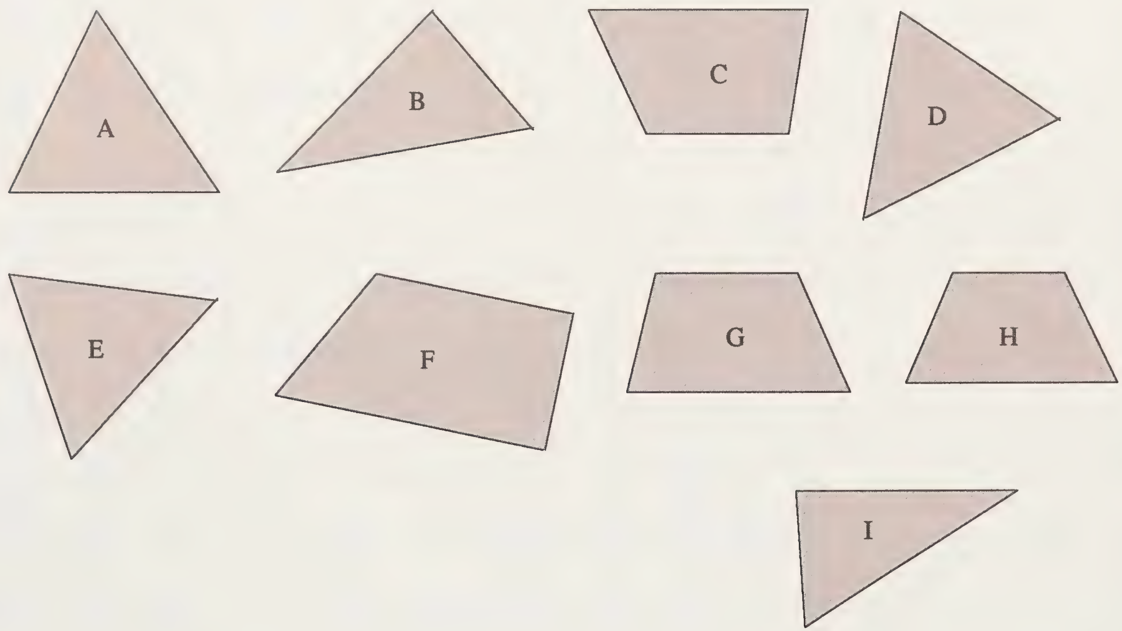
Volume: the amount of space occupied by an object

SECTION 1 FIGURES



SECTION 7 FIGURES

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